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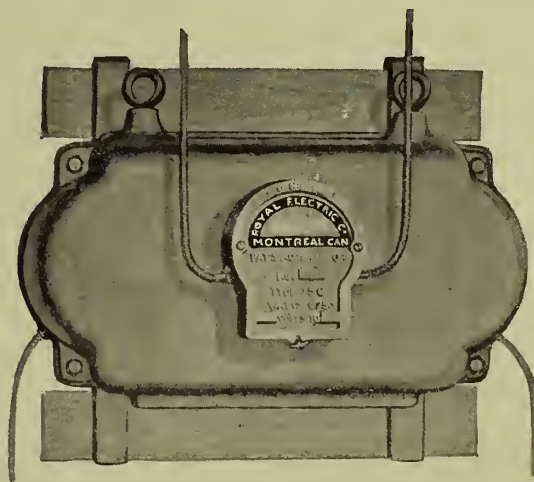
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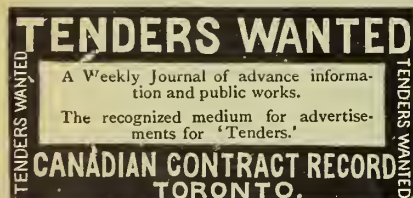
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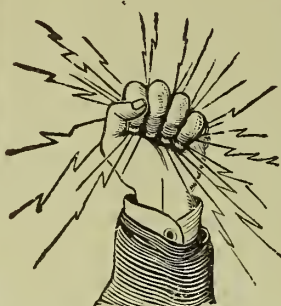
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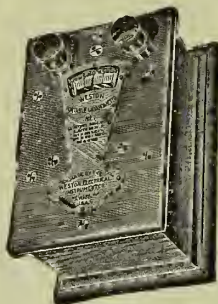
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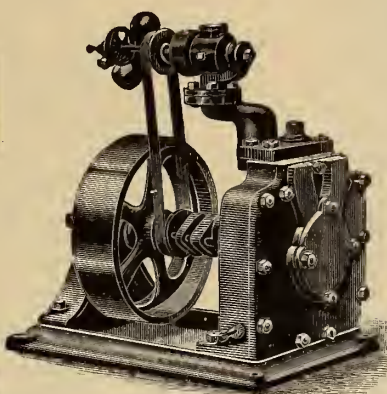
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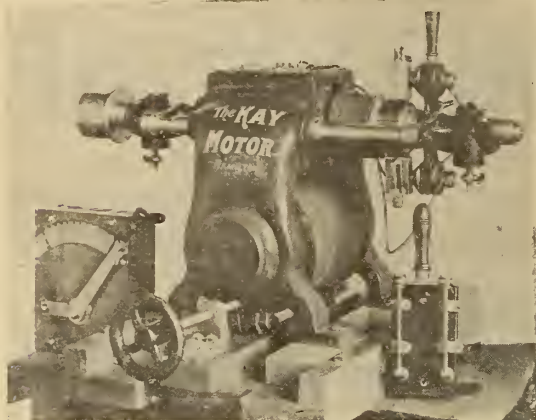
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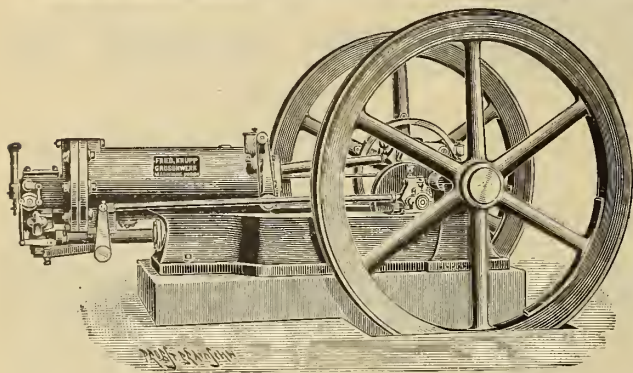
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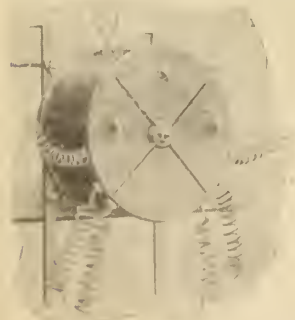
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CANADIAN
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AND
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JANUARY, 1897

No. 1.

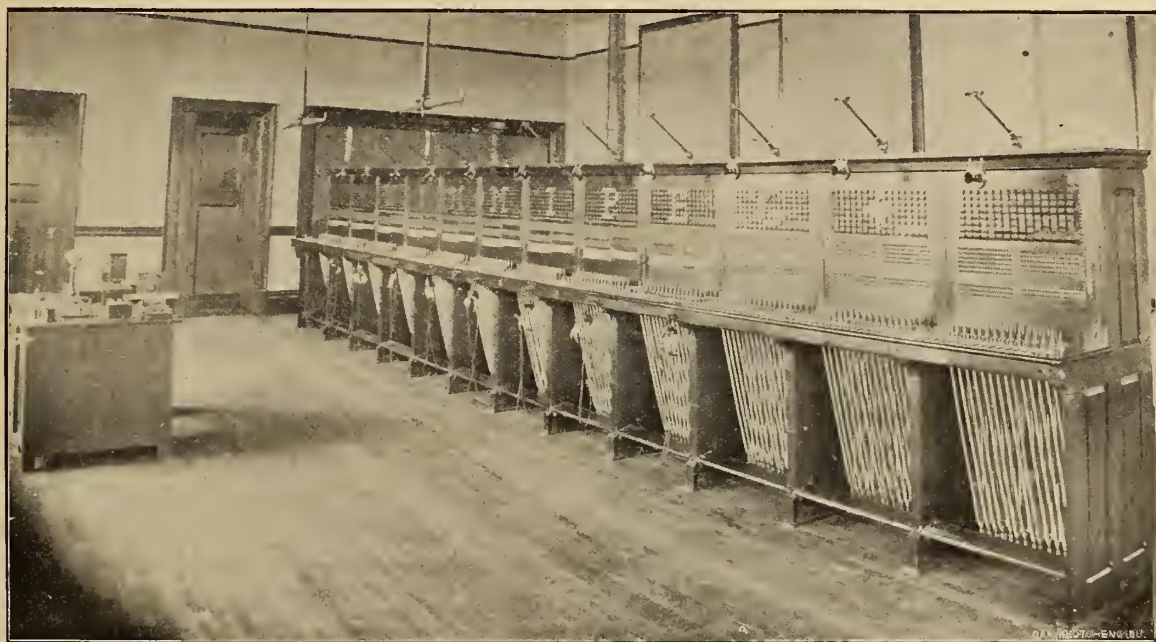
NEW BELL TELEPHONE EXCHANGE AT WINNIPEG.

THE Bell Telephone Company, of Canada, has recently completed a new exchange in the city of Winnipeg which is one of the most efficient in the country. The building is situated on Thistle street, near Main; constructed of white brick and faced with brown stone; it is two stories in height and is used exclusively by the telephone company.

In the basement are the distributing room, inspectors' and linemen's quarters and the heating apparatus. On

ard form in use in so many of the offices of the company. The switch has a capacity of twelve hundred lines. The present number connected up is about nine hundred. Each operator has charge of one hundred lines, which are brought through jacks to the annunciators in the usual way.

Some difficulty has, in the past, been experienced with boards, where it is necessary to transfer connections from one section to another, in having the line properly disconnected when the conversation was finished. A special feature has been introduced into



OPERATING ROOM, SHOWING FRONT OF SWITCHBOARD, BELL TELEPHONE EXCHANGE, WINNIPEG.

the ground floor are the company's general offices, with the district superintendent's private office, the power room, and a room in which is installed the city fire alarm apparatus, which is operated by the telephone company. The upper storey is used for the operating room and the operators' retiring and lunch rooms.

All the wires enter the building under ground in paper insulated cables, and are carried through flexible rubber cable-heads direct to the distributing frame, which is of the most modern type, and equipped with the best lightning arresters and strong current protectors known. The wire used in the distributing frame is insulated with wool, a novel feature, designed to make the mass of wires as flame-proof as possible. From the distributing frame the lines are carried in small cables up to the switch-board.

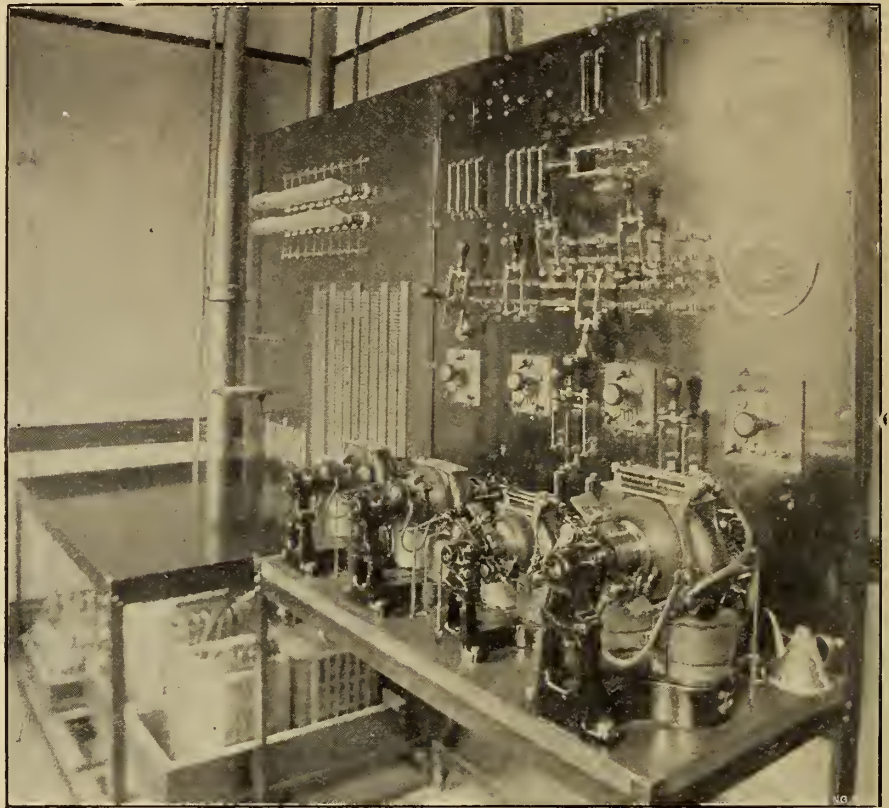
The switch-board is of somewhat novel construction, being a decided improvement on the well-known stand-

this board to obviate the trouble. One hundred and eighty transfer lines are multiplied through all the boards, fifteen being brought back and terminated at each section in cords and plugs. Let into the keyboard, in front of each plug, is a miniature four-volt incandescent lamp, connected up in such a way as to glow when the transfer line plug is in a jack and the other end of the transfer line is open, thus furnishing a most accurate disconnect signal.

The operation of making a connection from one switch to another is as follows:—Suppose operator on section No. 2 receives a call from subscriber 234, for subscriber No. 781—the operator on No. 2 section depresses the order wire key connected to the operator's telephone on the 7th section and says "781." The operator on the 7th section sees at a glance what transfer lines she has idle at her section; picking up any one of these plugs she repeats back to No. 2 operator "781

on 6" (for example), at the same time inserting the 6th transfer line plug into line jack 781. The operator on No. 2 section now inserts the front cord of the pair with which she has answered subscriber No. 234 into the 6th transfer line jack of the 15 leading to the 7th section. On the termination of the conversation the subscriber rings off, throwing the ring-off drop connected with the pair of cords in use on-section No. 2. The operator at the section comes in on the line after assuring herself that the conversation is finished, and withdraws the cords from the jacks. This causes the lamp in front of transfer plug No. 6 on the 7th section to glow, showing the operator at that section that the conversation is finished, whereupon she, in her turn, removes the plug from the jack and, on replacing it into its socket, the lamp goes out. These supervisory signals enable the operators to do very much more work than under the old system. All the details of the board—jacks, drops, keys, etc.—are of the very latest design and of the most substantial construction, and should ensure good service with a minimum amount of trouble.

The current for operating the switch-board and other



POWER ROOM, SHOWING MOTOR-GENERATORS, SWITCHES, STORAGE BATTERIES AND RESISTANCE LAMPS.

transmitters, supplying the four-volt lamps, operating the fire alarm, together with the alternating current required for signalling the subscribers, is furnished by the power plant on the first floor of the building. This consists of two motor-generators for charging storage batteries, and two motor-generators furnishing an alternating current for signalling the subscribers, four chloride cells furnishing current for the transmitters and lamps, and twenty-four small cells operating the fire alarm.

The power switch-board is of polished slate, on which are mounted all switches, lightning arresters, cut-outs, ammeters, etc., used in connection with the system.

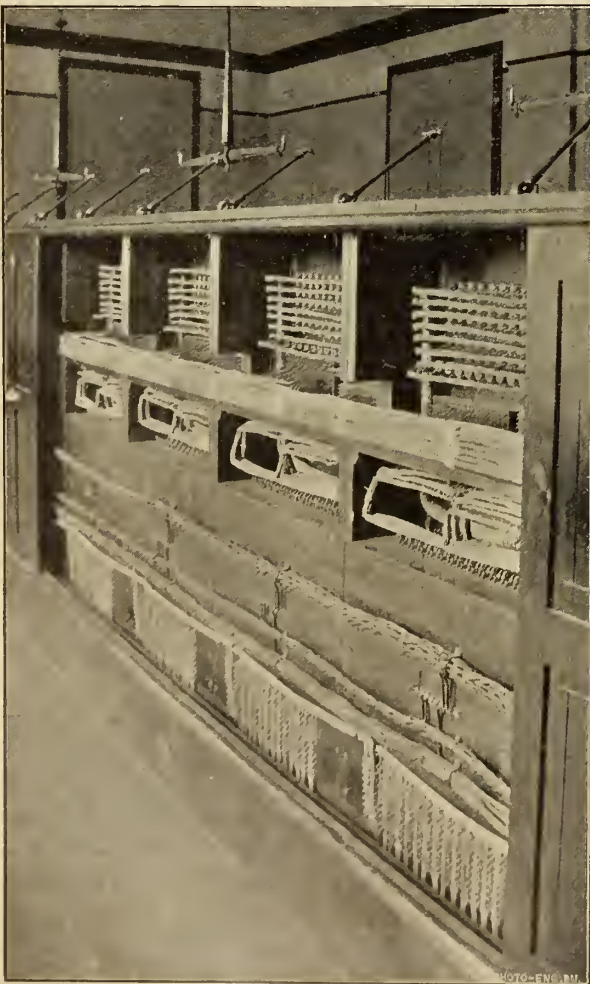
The lines were successfully transferred from the old to the new offices on the evening of the 25th October, 1896, the total time occupied in making the transfer of the lines being about two minutes.

The entire apparatus was manufactured for the Bell Telephone Company by the Northern Electric & Manufacturing Company, of 31 Aqueduct Street, Montreal.

Mr. F. G. Walsh, the district superintendent of the northwestern department of the Bell Telephone Co., has also the direct supervision of the Winnipeg office, with which he has been connected from the time of the first introduction of the telephone in the Northwest, and to his ability, energy and good judgment much of the company's success in this section must be ascribed.

The Winnipeg street railway system was recently tied up for several hours owing to a sudden thaw, followed by a blizzard. Manitoba is having an exceptional winter of sudden changes in temperature.

The new electric light plant at St. Mary's, Ont., was successfully started on the first of December. It is composed of twenty-eight 2,000 c.p. "Reliance" arc lamps, supplied with current from a Reliance dynamo, which is giving thorough satisfaction. It was installed by Mr. H. H. Ingram, of Seaforth, and is now in charge of Mr. Jos. H. Ward, electrician, late of Toronto, who is also installing a small incandescent plant to light Messrs. Weir & Weir's flax mills, which furnish the power for the arc plant.



REAR VIEW OF SECTION OF SWITCHBOARD, SHOWING METHOD OF WIRING.

FIRST CANADIAN MOTOR CARRIAGE.

THE interest which has been taken of late in the horseless vehicle in many parts of the world received a local impetus by the appearance on the streets of Toronto last month of the first motor carriage yet constructed or to be seen in Canada. Appearing shortly after the test which took place in England, and which is said to have been a good demonstration of the utility of this class of carriage, there was much interest manifested in the success of the trial trip, which revealed no disappointment.

The carriage was constructed for Mr. Fred. B. Featherstonhaugh, patent solicitor, the electrical equipment being the design of Mr. W. J. Still, of 70 Yorkville ave., Toronto. The general design of the carriage is after the style of the London hansom cab, except that the driver occupies a seat inside, instead of being perched up at the back. It is hung on ball bearings and mounted on three wheels, with 2-inch Dunlop pneumatic tires. The two wheels at the back are 28 inches in diameter and the front wheel 20 inches. It is supplied with a top, and as an extra precaution against the weather a celluloid blind, perfectly transparent, may be used when required. The total weight of the carriage is approximately 750 pounds, of which 370 pounds is for the electrical equipment. It is estimated that it could be placed upon the market at a cost of about \$650, including electrical equipment, which would cost from \$200 to \$300.

The storage battery is placed directly under the seat, and contains 12 cells weighing $23\frac{1}{4}$ lbs. each. They occupy a space about 16 x 24 inches and 14 inches deep, and are what is known as the lead-lead pasted type, being the invention of Mr. Still, for which patents have been applied. The electrical contents of the cells are $4\frac{1}{4}$ h.p. hours, or, in other words, they will give one horse power for $4\frac{1}{4}$ hours. The cost of re-charging is about twenty-five cents. Mr. Still claims that they are built particularly for high discharge rate work, and are fully one-half lighter than any storage battery yet placed upon the market. The controller has three positions, giving 6, 12 and 24 volts. It is an iron bar with a handle to the right of the seat, and is also used for steering. The device is very simple, and enables the driver to propel or reverse the carriage almost instantly. The motor, also the invention of Mr. Still, is four maximum h.p., and is supported on the back axle. It is geared 12 to 1 to the driving wheels, and hung on roller bearings. On the dash-board are two incandescent carriage lamps supplied by the battery.

Mr. Still states that the carriage differs from any yet constructed, both in the class of cells, character of motor and controlling apparatus, and is built especially for town and city purposes. When the battery is fully charged it is estimated that it will be capable of propelling the carriage about 60 miles before requiring to be re-charged, making an average of 12 miles an hour for five hours. On a level road three-quarters of a horse power is required per hour for its operation, but on steep grades this, of course, would be greatly increased. The trial trips which have been made on the city streets have fully met the expectations of those interested, and prove that at least the construction of the machine is mechanically and scientifically correct.

Mr. Still, the inventor of the electrical apparatus, is an Englishman, who came to this country seven years ago. He was not originally connected with electrical

work, but was prompted, he says, to make experiments in that line through sheer necessity. He required a motor for a special purpose, but could not obtain one to meet the requirements, so set to work to study the science himself, with the result that he shortly afterwards designed a motor and secured a patent therefor. Subsequently he turned his attention to the storage battery, and after diligent research his efforts promise to be rewarded. It is his intention to form a syndicate to manufacture cells and motors for railway and locomotive work. One of the objections to storage batteries has been their great weight, but this Mr. Still claims to have overcome in the article which he will shortly place upon the market.

QUESTIONS AND ANSWERS.

"R. M.," Milton, Ont., writes: How should I cut a coil out of an Edison exciter armature? Should I cut the two wires loose from the section and then close that section to the next one? What should I do with the wire that I cut loose? If the sections are near together can more than one be cut out?

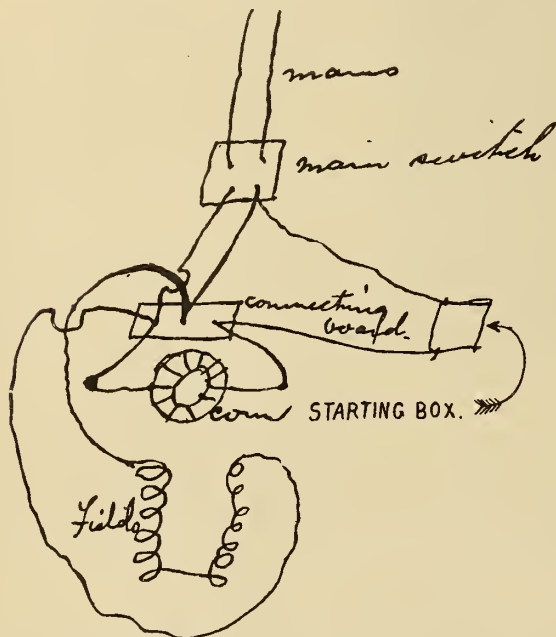
ANSWER.—We should suggest that if you feel in the least doubtful about the results of cutting out the coil, you should send the armature to some repair shop where they do such things. You have the general idea all right. Don't do anything with the wires you cut loose, but take care they don't come together or touch anything else. If they touched together they would form a closed circuit of low resistance in which a large current would continually flow, and great heat would probably result. You can, of course, cut out as many sections as you like, but must remember that the armature will probably lose its electrical balance.

"U.M.A.X." writes: Would you kindly let me know in your NEWS for January what causes an electric light machine to go to sleep, and the best thing to do in such cases. I am told that one of the machines in the Ottawa power house went to sleep, and after three or four days started up again. And is it not right to have all wires free from touching trees or branches? I claim that all wires should be clear, as such contact would cause grounds on the lines.

ANSWER.—The only thing that could cause a dynamo to "go to sleep" would be the complete demagnetization of the fields, and it is difficult to understand how this could occur in a place where the machines are run every night. It is more probable that a connection was loose somewhere, or a wire broken, so that the fields were not magnetized. It would be interesting to hear from Ottawa about this case. You are quite right in your claim that all wires should be clear of any chance of rubbing against branches, etc.; grounds are caused by this continual rubbing, which tends to scrape off the insulation, leaving the copper in actual contact with a body that is generally, at least, moist, and frequently quite wet, and therefore a good conductor. Besides which insulation is not much good anyway, and after a few months' exposure to the air will leak through.

"B. E.," Hawkesbury, Ont., writes: "As a subscriber to the ELECTRICAL NEWS, kindly assist me out of a difficulty. I am operating a 4 h. p. ball motor on a 110 volt straight current circuit, which formerly worked on a 4 ampere constant current circuit. If I am not mistaken the machine should require about 35 amperes at

110 volts, but I cannot get more than 25 amperes on the meter on the 25 K. W. Edison machine, from which it is driven. The winding is correct, having come from its maker. The connections are all correct, for it works well except as regards its power and speed. The distance from generator to motor is about 100 yards, and very little loss is shown on the volt meters. The data is No. 12 D. C. C. on armature (it being ring type), and No. 18 S. C. C. on field magnets. The field magnets show about the same strength of magnetism. The voltage test was taken while running. The mains from the generator are No. 8 B. & S. w. p. wire, and are sufficiently heavy for 35 amperes, the motors only requiring about 32 amperes at full load. The weight of field coils is 20 lbs. No. 18 B. & S. S. C. C. and armature 33 lbs. required No. 12 B. & S., D. C. C.; there were some five or seven pounds left over after winding the armature. I have enclosed a sketch of the connec-



tions. The speed of the machine is reduced to about one half when it is working.

ANSWER.—The wires leading from generator to motor are entirely too small. The safe carrying capacity independent of most advantageous size for No. 8 is only 25 amperes. The loss between generator and motor with 32 amperes at 100 yards with No. 8 B. & S. wire would be about 15 volts, or 14 per cent. There are other reasons, however, that might cause the trouble. The position of brushes may not be correct. The proportion of wire appears about right. It is difficult to diagnose a case unless we see the patient. I think, however, the whole trouble is that the line is too small.

PERSONAL.

Mr. George Campbell, manager of the Winnipeg Electric Railway, has severed his connection with the road, to engage in mining operations.

Mr. Maurice Quain, electrician, of Ottawa, Ont., left last month for Rossland, B. C., where he has secured a position with a large mining company. Before leaving Ottawa he was tendered a farewell supper.

Mr. Frank Green, electrician of the Hamilton, Grimsby and Beamsville railway, has resigned, and accepted a similar position with the Hamilton Radial Railway. It is expected that other changes will be made in the Hamilton, Grimsby and Beamsville railway at an early date.

Mr. R. G. Moles, proprietor of the electric light plant at Arnprior, Ont., declined to accept municipal honors at the late election, after serving for seven years as reeve and three years as mayor. During his regime the best interests of the town had been advanced, and his retirement was a source of regret to the citizens.

Readers of this journal will regret to learn of the serious illness of Mr. A. E. Edkins, inspector for the Boiler Inspection and Insurance Co., of Toronto, and Registrar of the Ontario Association of Stationary Engineers. An attack of inflammation of the lungs was followed by an abscess on the brain, which necessitated a surgical operation. For several days he was thought to be beyond medical skill, but as we go to press it is learned that he is somewhat better, and hopes are now held of his recovery. The ELECTRICAL NEWS joins with his many friends in hoping that he may speedily return to convalescence.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

LONDON NO. 5.

THE above association is in a prosperous condition, and all the meetings are well attended. Two new members have recently been initiated, and the applications of four others are now awaiting to be passed upon. At the last meeting a debate took place on "Steam Engine Economy," which was ably discussed and illustrated. The Association has been presented with forty catalogues from manufacturers.

KINGSTON NO. 10.

At a meeting of Kingston No. 10 held on December 10th, papers were read by Messrs. R. Priestly and W. Woodrow relating to the horse power of steam engines and boilers. Mr. F. W. Simmons followed by an essay on the latest production of electricity directly from coal, illustrating the subject by experiments and the use of charts. Below will be found the calculations of Mr. Priestly, which we have simplified in some respects:

RULE: To find the horse power of a boiler always find the number of square inches and divide by 144, which gives the square feet of heating surface, and divide by fifteen square feet, which is an average allowance for one horse power of a boiler. Divide the horse power by 2 and you have the proper grate surface, and allow $\frac{1}{2}$ square inch of safety valve to each square foot of grate surface generally. From $\frac{1}{2}$ to $\frac{3}{4}$ of a square foot grate surface is allowed to each horse power of a boiler. To find the horse power of a boiler, find the number of square feet of heating surface and divide by 15. Fifteen square feet of heating surface is the general allowance for a h. p. of a boiler.

EXAMPLE:

Let D=diameter.

T=tubes.

H=heads.

S=shell.

L=length.

Heating surface in S = $\frac{2}{3}$ of total area of S,
 $\therefore \frac{2}{3} (D \text{ of } S \times 3.1416 \times L \text{ of } S) = \frac{2}{3} (4' \times 3.1416 \times 25') = 209.44 \text{ sq. ft.}$

Heating surface in H = area of H - area of ends of 2 T.

$$2(D^2 \text{ of } H \times .7854) - 4(D^2 \text{ of } T \times .7854 =$$

$$2(4' \times 4' \times .7854) - 4 \frac{(16'' \times 16'' \times .7854)}{144} = 2.0944 \text{ sq. ft.}$$

Heating surface of tubes =

$$2(D^2 \text{ of } T \times .7854 \times L \text{ of } T) = 2 \frac{(16'' \times 16'' \times .7854 \times 25 \times 12)}{144} = 209.44 \text{ sq. ft.}$$

Total heating surface = $209.44 + 2.0944 + 209.44 = 420.9744 \text{ sq. ft.}$

15 sq. ft. per h.p.

$\therefore \text{h.p. of boiler} = \frac{420.9744}{15}$, or about 28 h.p.—Ans.

RULE: To find the horse power generated in any kind of a boiler when running, first, notice how long it will take to evaporate 1 inch of water in the glass gauge, divide this into 60, which gives number of inches evaporated in one hour; second, multiply the average diameter where evaporation took place by the length of the boiler in inches; this multiplied by the number of inches evaporated and the answer divided by .1728 gives the cubic feet of water evaporated in one hour.

There is no such thing as a horse power to a steam boiler—it is a measure applicable only to dynamic effect; but as boilers are necessary to drive steam engines the same measure applied to steam engines is now universally applied to the boiler. The standard as fixed is one cubic foot of water evaporated per hour from and at 212 degrees. For such horse power this at that time was the requirement of the best engine in use. At the Centennial Exposition in 1876, a board of engineers selected from all parts of the world adopted as a standard for tests of boilers 30 pounds of water evaporated per hour under a steam pressure of 70 pounds per square inch as representing one boiler horse power. The general rule in estimating horse power of boilers is based on its evaporating one cubic foot of water horse power per hour one foot, or $62\frac{1}{2}$ pounds, or $6\frac{1}{23}$ gallons of water evaporated per hour is equivalent to one horse power; that is, a boiler that will evaporate ten cubic feet of water, 625 pounds of water, or $62\frac{2}{3}$ gallons of water per hour is a boiler of 10 horse power.

CHEMISTRY IN THE BOILER ROOM.

By WM. THOMPSON, Montreal West.

PERHAPS a more elaborate heading might have been chosen, but after careful consideration of the importance to be attached to the requirements of the engineering profession and the actual need of at least a rudimentary education in chemistry before an engineer can become acquainted with what is really taking place in the plant under his charge, I cannot think of a more suitable or appropriate title for the subject to be discussed.

All engineers, no matter how practical, require a theoretical education, and to this end associations have been established where engineers can meet together and discuss the various branches of their profession. Varying degrees of success have been attained, and in a large number of cases a new enthusiasm has been propagated and many engineers have been turned from mere "machines" to thoughtful, earnest men, anxious to know their business, and resulting in a new class of engineers having been formed who are well acquainted with the nature of the duties required of them, and giving to the steam-user a greater degree of confidence in the ability of his engineer; on the other hand giving to the engineer a degree of confidence in himself that was formerly an unknown quantity, and establishing the usefulness of the steam engine as a producer of power more fully and with more favor than heretofore.

The designer and builder of steam engines and boilers in Canada has, I think, kept pace with the demand upon his energy and resources, and he can to-day bravely and confidently face competition from whatsoever source, and prove that a steam plant is not the hungry article many people would have the consumer believe. The designer, however, to enjoy success, must of necessity have the co-operation and assistance of the operating engineer. A modern plant in the hands of an engineer who only knows enough to oil and "tinker" stands a mighty poor chance of proving an unqualified success. The importance of this has already been evidenced by the establishment by the engineers themselves, of the organizations already mentioned, and more particularly by the establishment in our leading universities of faculties to impart this important knowledge. A new era seems to be opening up in engineering circles, when ability will be more readily recognized and when an engineer will require another kind of ability than that necessary to do a certain amount of manual labor in a given time, or a certain amount of wire-pulling to secure a "job." Prominent evidence of this can be seen by the recent decision of the Toronto City Council to appoint the engineer to the new city hall by a competitive examination.

Public safety demands that every engineer should pass a qualifying examination before being allowed to take charge of a steam plant, although, unfortunately, we have no general law to this effect. Where these examinations are in effect, candidates are examined on what may be termed a graduated scale, and certificates granted accordingly. The examination comprises, as it very properly should, a close examination on the strength and management of boilers—such as the required thickness of plate, diameter and pressure being given; the safe working pressure, thickness of plate and diameter being given; the strain per sectional inch, thickness of plate, diameter and pressure being given; the required strength of furnaces and flues under varying conditions; strength of plate at joints as compared with solid plate; strength of all rivetted joints, etc. In other words, the examination proceeds under the well known theory that the weakest part of a boiler is its greatest safe working stress, and no engineer should under any circumstances be allowed to take responsible charge of any steam boiler until these questions are thoroughly understood, any more than a navy out of a ditch should be called upon to prescribe for a case of smallpox or other disease.

If, then, public safety requires the engineer to have a certain theoretical as well as practical knowledge and experience, his employer will require a certain other knowledge, and his own pride and skill in his employment will demand that he acquire all the knowledge possible as to what takes place from the coal pile to the time he turns out his power as the finished article. Unfortunately this knowledge is not easily acquired even after years of experience, and when the engineer has mastered the operation of his engine, he stops there and looks no further.

Every engineer who is at all observant knows that combustion takes place under certain defined conditions, and that in many cases a sediment is formed in his boiler feed water that is a constant cause of anxiety to him and a menace to the life of his boiler, and that from some cause or other a certain deterioration gradually takes place in his boiler plates, stays and other acces-

sories; that different conditions exist under different circumstances, and to such an extent that it seems almost impossible to master the various difficulties.

A close student of chemistry will find that in nearly every case the cause of these varying conditions is the result of a certain chemical reaction constantly taking place, and also that a knowledge of chemistry, enabling the operator to understand the reaction, will also enable him to neutralize the reaction to a greater or less degree. Hence it becomes essential that an engineer, to thoroughly understand and comprehend what is constantly taking place from coal pile to finished power, requires a knowledge of chemistry, and the more complete our chemical knowledge, the better and more proficient engineers we shall certainly become.

It is not my intention to undertake at the present time to discuss all the chemical reactions that may usually be expected to take place, but in the present instance to discuss, and as plainly as possible, the chemical reaction constantly taking place during the combustion of fuel.

As every engineer knows, coal is a black, inert mass, obtainable in many grades and degrees of efficiency; that when supplied with draught and heat it burns up and disappears, giving off during this operation both heat and light, and that it is this peculiarity that makes it so valuable and generally used for the production of power. If our knowledge stops here we have really learnt nothing of any importance. Then, engineers, go still further, and note that during the process of "burning," as usually styled, certain gases are formed which have a given calorific value, and to save fuel we must take precaution to utilize these gases. We know as a matter of fact that these inflammable gases had no existence as such when coal was placed in the furnace, consequently they must have been formed after being placed within the furnace, and by some process not at once understood. We all know this to be an actual fact; then in the face of this, is it not reasonable for us to endeavor to learn—first, what is the composition of coal that gives it this peculiarity of burning up and throwing out heat? We know that it does this, but "why?" Why will not clay, iron, stone, sand or any other mineral do the same work or behave in the same way under similar conditions? We know they will not, but when asked "why?" we have simply to say we do not know. Now, if coal has this peculiarity, and under certain conditions forms gases, there is certainly a reason for it, and fortunately for us the chemical art places all these things in simple array before us, so that they are easily understood and actually placed under our control. This very fact leads me to say that the more chemical knowledge we can obtain, the better engineers we shall become. No matter how clever you are you cannot intelligently operate an engine unless you understand it, and for the same reason you cannot intelligently produce power from coal unless the process of combustion is fully understood. We want to know what coal is, what are its component parts, what makes it burn, why gases are formed, what they are, how formed, how burned to give best results, and why, when coal burns, it gives off heat, and how much, and finally what becomes of it.

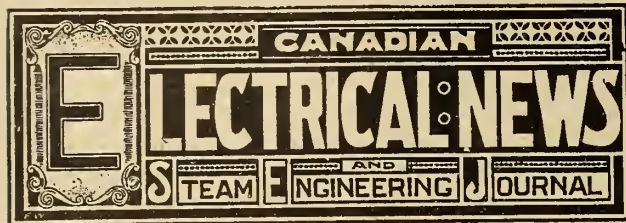
Coal burnt is not destroyed; it has simply changed from a black inanimate mass into some other substance or substances which we shall consider later on.

(To be Continued.)

IMPORTANT PATENT DECISION.

By recent decision of the United States Circuit Court at Cincinnati, O., the Dodge and Phillon patent for separable wood pulleys, covering the compression fastening and interchangeable bushing system, is broadly sustained. Under the patent laws, the user, the seller and the manufacturer are all held to be infringers and liable as such to the owners of the patent. The Dodge Wood Split Pulley Company, of Toronto, is taking proceedings against infringers of their patent in Canada.

We have received from the publisher, Mr. Chas. A. Hewitt, 510 Royal Building, Chicago, a copy of a book entitled "The National Electrical Code," by Price & Richardson, electrical engineers. It is an analysis and explanation of the Underwriters' electrical code, and the common analogies and simple definitions used make it easily intelligible to non-experts. The authors have undertaken to explain the matter in ordinary language for the special benefit of insurance inspectors and electrical students, as well as central station men. In the appendix are found tables and curves for measuring wires, and the full text of the underwriters' code. Price \$2.00.



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EDITOR'S ANNOUNCEMENTS.

Correspondence is invited upon all topics legitimately coming within the scope of this journal.

The "Canadian Electrical News" has been appointed the official paper of the Canadian Electrical Association.

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ROSS MACKENZIE, Manager Niagara Falls Park and River Railway, Niagara Falls, Ont.

A. B. SMITH, Superintendent G. N. W. Telegraph Co., Toronto.

JOHN CARROLL, Sec.-Treas. Eugene F. Phillips Electrical Works, Montreal.

C. B. HUNT, London Electric Company, London.

F. C. ARMSTRONG, Canadian General Electric Co., Toronto.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

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Vice-President, E. J. PHILIP,	11 Cumberland St., Toronto.
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TORONTO BRANCH NO. 1.—Meets 1st and 3rd Wednesday each month in Engineers' Hall, 61 Victoria street. John Fox, President; Chas. Moseley, Vice-President; T. Eversfield, Recording Secretary, University Crescent.

MONTREAL BRANCH NO. 1.—Meets 1st and 3rd Thursday each month, in Engineers' Hall, Craig street. President, John Murphy; 1st Vice-President, J. E. Huntington; 2nd Vice-President, Wm. Smyth; Secretary, B. Archibald Vork; Treasurer, Peter McNaughton.

ST. LAURENT BRANCH NO. 2.—Meets every Monday evening at 43 Bonsecours street, Montreal. R. Drouin, President; Alfred Latour, Secretary, 306 Delisle street, St. Cunegeonde.

BRANDON, MAN., BRANCH NO. — Meets 1st and 3rd Friday each month in City Hall. A. R. Crawford, President; Arthur Fleming, Secretary.

HAMILTON BRANCH NO. 2.—Meets 1st and 3rd Friday each month in Maccabee's Hall. Wm. Norris, President; E. Teeter, Vice-President; Jos. Ironside, Corresponding Secretary, Markland St.

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LONDON BRANCH NO. 5.—Meets on the first and third Thursday in each month in Sherwood Hall. G. B. Risler, President; D. Campbell, Vice-President Wm. Meaden, Secretary-Treasurer, 533 Richmond street.

GUELPH BRANCH NO. 6.—Meets 1st and 3rd Wednesday each month at 7.30 p. m. H. Geary, President; Thos. Anderson, Vice-President; H. Flewelling, Rec.-Secretary; P. Ryan, Fin.-Secretary; Treasurer, C. F. Jordan.

OTTAWA BRANCH NO. 7.—Meet every second and fourth Saturday in each month, in Borbridge's hall, Rideau street; Frank Robert, President; F. Merrill Secretary, 352 Wellington street.

DRESDEN BRANCH NO. 8.—Meets 1st and Thursday in each month. Thos Steeper, Secretary.

BERLIN BRANCH NO. 9.—Meets 2nd and 4th Saturday each month at 8 p. m. J. R. Utley, President; G. Steinmetz, Vice-President; Secretary and Treasurer, W. J. Rhodes, Berlin, Ont.

KINGSTON BRANCH NO. 10.—Meets 1st and 3rd Thursday in each month in Fraser Hall, King street, at 8 p. m. President, F. Simmons; Vice-President, J. W. Tandvin; Secretary, A. Macdonald.

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KINCARDINE BRANCH NO. 12.—Meets every Tuesday at 8 o'clock, in McKibbin's block. President, Daniel Bennett; Vice-President, Joseph Lighthall; Secretary, Percy C. Walker, Waterworks.

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BROCKVILLE BRANCH NO. 15.—Meets every Monday and Friday evening, in Richards' Block, King St. President, Archibald Franklin; Vice-President, John Grundy; Recording Secretary, James Aikins.

CARLETON PLACE BRANCH NO. 16.—Meets every Saturday evening. President, Jos. McKay; Secretary, J. D. Armstrong.

ONTARIO ASSOCIATION OF STATIONARY ENGINEERS.

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Information regarding examinations will be furnished on application to any member of the Board.

In all business it is of importance to balance up at certain periods—to take stock of what is left in hand, to see whether the business has improved or not since last stock-taking, and from the operations undertaken to derive some useful information which may increase the experience, or indicate in what particular direction the business will be capable of extension in the future. Engineering works are as easily reduced to book-keeping as any other business, and it will be of considerable value to every engineer—no matter whether he belong to the civil, mechanical, or electrical branch of the profession—to periodically edit, so to speak, the experience gained during the preceding year or so, with the view of enabling him either to avoid errors in the future or of strengthening his convictions along any particular line. In electricity such a review is likely to be of even greater value than in the other branches, for the science is now in the period of vigorous growth and extension, when almost every week adds something new to our knowledge, and experiences crowd in so thick and fast that we are sometimes almost bewildered with their number and variety. And yet it will never do to say "Enough," for a slight halt will mean falling far behind in the race of progress. This progress has become evident along very many lines, and has every prospect of being permanent. As the student becomes more and more interested in the countless problems presented to him, so does his desire for knowledge increase, so does his comprehension improve, and in like proportion do his results become more satisfactory. It is especially remarkable that for some time, the interest evinced by those responsible for the operation of electric lighting and power houses in Canada has stimulated a more thorough investigation into the economics of central station practice. These investigations have been fruit-

ful of results, leading in very many cases to a startling change in methods of operating, and in some few to scrapping or alteration of entire plants. It is observable that electric plants are being more and more recognized as capable of careful designing; that the opinion is growing and taking firm hold, that the various component machines and apparatus are all intended to work together as one coherent, harmonious whole, and that therefore the due and proper proportion of boilers, engines, generators, etc., to each other should be carefully calculated. This conviction has led to considerable attention being paid to the preliminary engineering, to which little or no importance used to be attached. Speaking generally, however, the past year has been memorable for the breaking away from old-time ideas and opinions, for the somewhat cautious acceptance of those principles of practical electricity which have been experimentally determined in Europe and the United States, and for the general awakening to the fact that electricity is a special science, to be studied as such. We are now shaking off the fetters placed on the industry by an extreme conservatism; we are climbing out of the ruts marked for us by manufacturing exigencies, and are learning more to think for ourselves. This is really the cause of the developments that have taken place along many lines, and is a favorable augury for the future. The lines of progress may be grouped into probably four, viz.: Improvements in Engineering Practice; Improvements in Manufacturing; Improvements in Operating Practice; Application of Electric Power in New Directions.

Taking these up seriatim: It is quite remarkable how, in the last twelve months, the engineering of electrical enterprises has received great and increasing attention. The European practice of placing all engineering details from water power or steam plant, right up to the distribution system of a lighting, or the transmission system of a railway plant, in the hands of competent engineers in independent practice, is apparently becoming more favorably considered among us, with the most beneficial and evident results. By the adoption of such a course electrical enterprises have been more and more planned with reference to the engineering and commercial conditions of a particular case; have been designed as means to particular ends, and less and less as so many "ads" for a particular "system." In this we are adopting the course so strongly recommended by American electrical publications, as tending to better engineering, and therefore to greater pecuniary success.

In manufacturing also we have seen great improvements and extensions. At least two quite new manufacturing companies have entered the field, and purchasers have now a very much more extended market wherein to select what they consider most suitable for their wants. For lighting purposes we now are able to choose between generators representing three well known types—inductor, iron-clad and surface-wound armatures. Alternating arc lamps, and long burning arcs on constant potential circuits, are quite numerous, and giving good satisfaction, and what is of special importance to single phase central stations, a single phase alternating current motor is now obtainable, and giving good results, in sizes up to 10 h.p. and larger. Whereas a couple of years ago direct current generators and motors were sold only by about four companies, now

we find at least nine different makes, and all good. The consequent competition, while it has greatly reduced the cost of goods, has also happily necessitated great improvements in their quality and efficiency; competition has been along the lines of improvement as well as along that of price only. In lamps and transformers the same result is noticeable—competition has forced a much closer study of the principles of design and construction of all apparatus, with consequent benefit to the purchaser. In alternating current apparatus the market has been extended so as to include two new makes of generator, and at least one entirely novel form of watt-meter. Electric railway apparatus does not seem to have broken new ground yet, although in the near future we may reasonably expect great advances.

As power machinery, two and three-phase generators, with motors both induction and synchronous, represent quite the highest development of such apparatus, we would not be justified in expecting any marked improvements or modifications for some time yet. In this line probably the most interesting and important achievement is that by which we are enabled to transform a set of currents bearing one particular phase relation to another set bearing a quite different relation. That is to say, we can transform a two-phase to a three-phase, and vice versa; so that, for instance, current may be generated in two-phase by a suitable machine, and if desired it can be transmitted to any reasonable distance as a three-phase and then transformed back to a two-phase or used as a three-phase, as may be most convenient.

In steam engine circles we have had occasion to welcome the introduction of another first-class high-speed engine. In the matter of improvement in operating practice the industry has great cause to congratulate itself on the marked progress made, and more especially on the fact that it is a natural one, having been started spontaneously in operating circles, and not as a kind of unnatural growth. The continually increasing interest taken in electrical matters by the owners and operators of central stations, large and small, has led to a more careful investigation into results, which in turn has itself pointed out many possible economies. Younger men are more frequently found in the positions of electrician and engineer—men whose ideas have not been formed in the very early days of electrical activity, and who therefore have had nothing to unlearn before acquiring the new notions. Study seems to be more general, and the conviction growing that in electricity the more one studies the more one finds to study. In steam practice particularly, it is very encouraging to find that properly qualified engineers, holding certificates from some recognized authority, are more generally sought for, and that the holder of a certificate takes a better position, and frequently can command higher pay, than one not so vouched for. This is entirely as it should be, and we should like to see the principle extended to the granting of certificates, after due examination by some competent authority, to electrical men. This infusion of younger blood has had very beneficial results in many cases, and it is not difficult to predicate that within the next few years we shall hear a different story from central station men who now write in the doleful plaint: "Electricity doesn't pay."

In the line of new enterprises we can chronicle some that place Canada at least in respectable competition

with other countries. When the Lachine Power Co. and the Chambly Power Co. have completed their constructions, Montreal will take a front place among cities as regards its power facilities; and there are other proposed power enterprises, such as that of the Keewatin Power Co., whose magnitude will be unrivalled. The advantages of electrical distribution of power through factories and cities have been more cordially acknowledged by the manufacturing interest, and we see with satisfaction that motors are used in cotton mills, paper mills, etc., displacing small, inefficient steam engines. Electricity is also forcing its way "electrolytically," as witness a western Ontario salt works using current for the electro-deposition of salt. It is to be regretted that storage batteries are not yet received among us, as aids in power houses. In the railway line there has not been a great deal to notice, but the very many enterprises in the promotion stage augur a wonderful activity in the near future. There has been for some time before the public a proposed long railway to connect points in eastern and western Ontario, utilizing several water powers along its route, and transmitting current therefrom over great distances, but it is well to be cautious in expressing any opinion as to such very extensive enterprises.

A forecast of probable electrical developments in the near future seems to indicate a great activity in all lines. Manufacturers will in all likelihood have their hands full of business, but competition—if the public cares to avail itself of the advantage—will keep prices down. Inductor type alternators, both single and polyphase, will probably grow in favor and in time displace the older types of armature. We hope to see the 220-volt lamp take a front place in new work. In railway work it seems probable that the alternating current will evolve up to the commercial point, and produce an induction motor suited for railway requirements. We also hope and believe that the improvement in operating practice will be even more satisfactory during the coming twelve months than in the past. We would suggest that the good resolutions for '97 should include the following: Careful reading and study; an examination into the economics of our power houses; an experimental study of our distribution systems, including transformers; a sharp look-out for any new methods or devices whereby we can increase our efficiency or decrease our expenses.

THE Montreal Street Railway Company Turkey and Pudding. are said to have distributed six tons of turkey and three tons of plum pudding among their employees at Christmas. We are not informed as to whether the company's system was in workable condition or not on the day following the festival, but presuming it to have been, it speaks wonders for the digestive powers of the staff.

Standard of Efficiency for Incandescent Lamps.

A COMMITTEE recently appointed by the German Electrical Institute to investigate this subject, and draft a set of standard rules and regulations for the guidance of manufacturers and consumers, has concluded its labors. Among the recommendations is one to permit of a variation of 2 per cent. in the voltage marking of lamps ordered, the lamps to be tested by the marking. It is suggested that a variation of 6 per cent. in candle power or energy be permitted, but the lamps may be rejected

if it is found that upwards of 25 per cent. of the lamps tested exceed these limits. The standard of lamp life is to be the number of hours at which the lamp has lost 20 per cent. of its rated candle power when operating at normal voltage.

Prevention of Accidents from Electricity. A CARD containing warnings and suggestions designed to prevent injury to persons from contact with electric currents has been issued by the Manufacturers' Accident Association of France, to be posted in all factories where electric currents or electric apparatus are employed. It is prescribed that work, workmen, iron tools, or other objects not connected with the electrical machinery, should not be allowed to come in proximity thereto. It is recommended that rubber carpets or mats or board platforms supported on glass or brick should be placed on the floor about the machines for the attendants to walk upon while in the discharge of their duties. Attention is called to the fact that an imperceptible puncture will destroy the protective quality of a rubber glove, and for this reason persons handling wires should use one hand only and keep the other as far removed as possible from wire or metal of any kind. In case fire should appear around any wire, switchboard, or other electrical apparatus, it is absolutely forbidden to throw water or wet cloths on it, or to allow anything of the kind to come in contact with any wires or electrical apparatus whatever until the current has been shut off from the locality by cutting the wires or otherwise. High tension wires are not to be touched on any pretext, however thick the insulation; and no person is to be allowed to enter, without special authority, the place where transformers are installed, or to carry a light or smoke in a room containing accumulators. In regard to the latter it is explained that the action of accumulators is accompanied by the evolution of hydrogen gas, so that explosions may easily occur, unless the place is well ventilated and fire kept out of it.

The Future of the Horseless Vehicle.

ELSEWHERE in this number is printed particulars of a motor carriage which has been invented, manufactured and practically tested in Toronto. The vehicle is propelled by electricity generated by a storage battery. While it is gratifying to know that Canada is well to the front in this as in other lines of development, the question presents itself, what useful purpose is likely to be served by such a vehicle that is not now as well served by the horse, the electric car and the bicycle? In other words, can the need for motor vehicles be demonstrated in a way to lead to their introduction and use on a large scale? To us it does not seem probable that they could be made to displace the horse to any extent either outside or inside of cities. In the country the horse is employed for a variety of purposes in addition to traction. This, added to the fact that ordinary horseflesh is cheap and cheaply maintained for country purposes, seems practically to shut the door in this direction to the motor vehicle. On the contrary, in cities, transit requirements for freight and passengers appear to be cheaply and efficiently supplied by horses, electric cars and bicycles. Even now, as compared with a few years ago, horses have largely disappeared from our streets. Those that remain are chiefly employed for cartage purposes or for the pleasure of the wealthy. For neither of these purposes does the motor vehicle seem as well adapted

or likely to come into favor. It might be employed for the carrying of light parcels, but unless its estimated cost can be greatly reduced, it will prove too expensive for this purpose. If any of our readers can find a basis on which to form a more sanguine estimate of the outlook for the motor vehicle, we would be pleased to publish their views on the subject.

BY THE WAY.

ONE of the most attractive window advertisements ever shown in Canada has been constructed by the aid of electricity, to draw public attention to the Massey-Harris Company's bicycle. The frame of a bicycle placed in the window of the company's show-room on Yonge street, Toronto, has been covered with small incandescent lights, which, when lighted, display the outline of the machine in a variety of beautiful colors. By the aid of a miniature electric motor the machine is shown in operation. Electricity played an important part in the window decorations of the great stores during the holiday season, and is continually coming more and more into evidence for decorative purposes at public and private assemblies.

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THE revolution in lighting which was predicted from the discovery of acetylene gas has not assumed a material form, and, judging by the indications, never will. If the discovery had been as valuable as many persons supposed it to be, the time which has elapsed since it was publicly announced would have sufficed to give it a commercial standing. Instead of advancing it appears to be fast retrograding in public esteem, as it becomes better known. Its dangerous character can be judged by the restrictions with which the Chicago Board of Underwriters has surrounded its use. These restrictions are briefly as follows:—“The apparatus for the generation or storage of the gas or of calcium carbide to be contained in a fireproof building detached from any insured building at least ten feet, and not elsewhere on the premises. 2. The valves or devices of whatever nature for controlling the pressure of the gas shall be located inside the fireproof building above described, and a cut-off provided between said building and the building insured. 3. The piping of the building insured shall be provided with a pipe outlet into the open air, controlled by a safety device so arranged as to let the gas escape outside the building insured whenever the pressure on the piping in the building exceeds four ounces to the square inch. This permit is granted in consideration of the agreement of the insured to comply with the above restrictions and conditions. The generation, storage or use of acetylene gas or of calcium carbide in violation of the restrictions and conditions named is hereby agreed and declared to be an increase of hazard that is not assumed under this policy, and in case of any such violation this policy shall thenceforth be null and void.” It is a foregone conclusion that a method of lighting which is thus marked “dangerous,” and which can only be used under special and inconvenient conditions such as those stipulated by the Underwriters' Association of Chicago, will never find its way into general use. The trend of events in relation to this discovery is also seen in the fact that shares of the Acetylene Company, of New York, after being quoted at \$400, are said to have been recently sold for 50 cents.

KEEP ON ADVERTISING.

No business man not yet dead in the shell but can see even in dull times an opportunity to let the world know that he is alive. In advertising one's business it is perhaps three times out of four a blind and fatal mistake to leave the public in the dark as to whether the factory is still running and the owner thereof alive or dead. No industry that is not overdone or wrongly located can be effectually downed by a spell of depression. Consumers do not quit the world as some gentlemen did in the days of Noah, and if unable to purchase what they need to-day, the same need speaks for itself to-morrow. When the wind is low, mend your sails, and the man who is prepared for the breeze is the man most benefitted by the same.—Power and Transmission.

IT may serve to illustrate the ability of the electric light to hold its own against any other form of illuminant, if I repeat a little story which a friend of mine related to me the other day. “I had occasion,” said he, “to visit recently a little German village in Western Ontario, and was surprised to find the streets and business places lighted by incandescent lights. In the hotel where I put up there were twelve lights. Curious to know what profit was being made by the owner of the lighting plant, I enquired of the hotel man, how much his lights cost him. “Shust von cent each for efery nighd,” was the reply. “Do you mean to tell me,” said I, “that you pay only about 70 cents per week for 12 incandescent lights.” “That's shust about id,” said he, and added, “it ust to cost me 20 cents a nighd ven I burnd lamps.” “Well,” said I, “I guess the owner of the lighting plant doesn't make anything out of the business.” “Doesn't he?” replied the hotel man, with a sarcastic smile, “he gets his mill lighted for noddings!” It will doubtless be comforting to the hearts of owners of electric lighting plants to know that in one instance at least the modern illuminant has been able to distance all competitors, but municipal corporations and others will do well to beware of drawing from this incident the inference that there are heaps of money to be made in the electric lighting business.

APPARATUS FOR TESTING COAL.

AN apparatus by which an engineer may test or determine the quality and adaptation of the coal he receives is described in the Boston Journal of Commerce. The test is not intended to be an analysis, but principally to show the amount of fixed carbon in the coal and the percentage of ash. As each carload of coal is received, samples are taken from twenty or more parts of the car, thoroughly mixed and quartered, each quarter being also mixed and quartered until the sample is obtained; this sample is then carefully weighed, the volatile matter driven off, weighed again, and the carbon consumed and the ash weighed. This estimate is important in guarding against the use of coal having an undue percentage of ash. The various coals differ in percentage of ash which they contain, some Cumberland coals having from 12 to 14 per cent. of ash, while a good New River will have as low as 3 or 4 per cent. Thus, though the coals may look alike to the average engineer, the heat value characterizing them is 10 per cent greater in one description than the other, and, ascertaining this, an important saving in the cost of fuel may result.

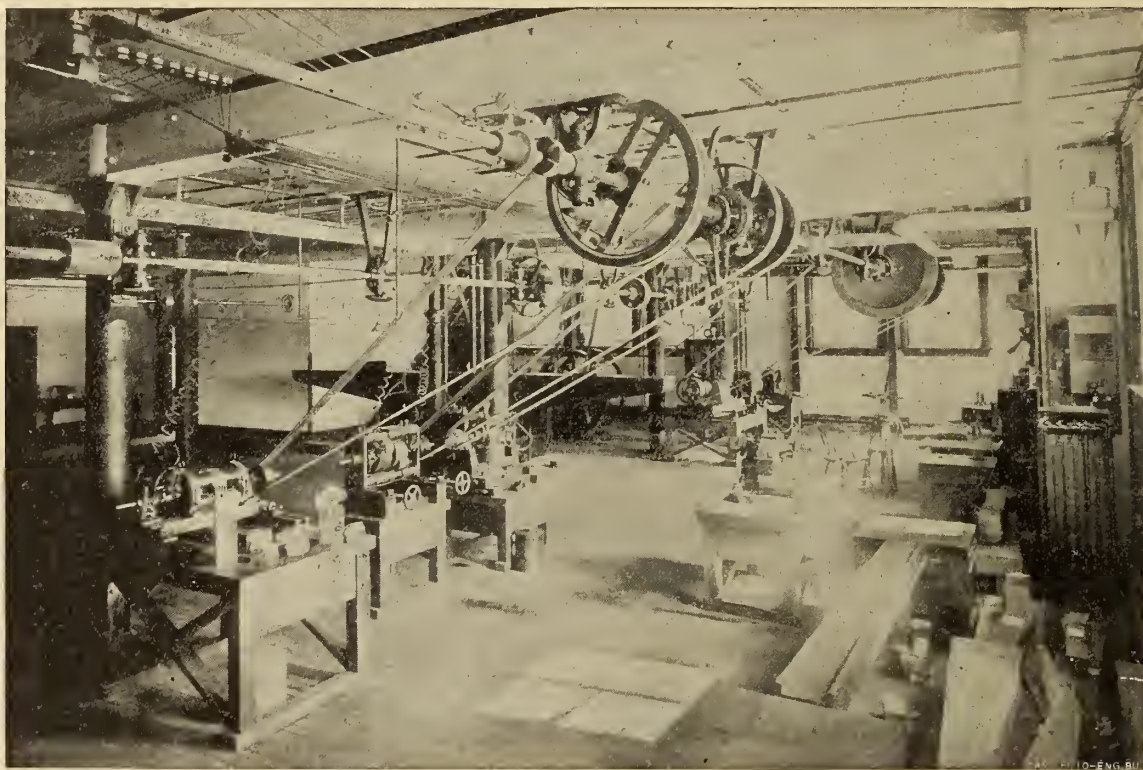
TORONTO SCHOOL OF PRACTICAL SCIENCE.

THE necessity of providing facilities by which the young men of the country might obtain a thorough scientific training, to fit them for the positions which were afforded by the developments in the civil, mechanical and electrical engineering field, was first recognized by the Ontario Government in the year 1887, when an act was passed sanctioning the establishment of a School of Practical Science. Arrangements were made with the Council of University College by which the students of the School of Science were permitted to enjoy the advantage of the instruction given by the University professors in all the departments of science embraced by the work of the school, and when, in 1889, these departments were transferred to the University of Toronto, the Senate passed a statute affiliating the school with the University. In that year Professor Galbraith was appointed by the govern-

this journal are more particularly interested. The engineering laboratory occupies two floors, and has a total area of 10,000 square feet. It is divided into three departments—the department for testing materials of construction, the department for investigating the principles governing the application of power, subdivided into the steam laboratory, the hydraulic laboratory, and electrical laboratory, and the department for investigating problems connected with standards of length, time, astronomical observations, etc.

In the equipment for testing materials is included an Olson torsion engine for testing the strength and elasticity of shafting. This machine will twist shaft up to 16 feet in length and two inches in diameter. The equipment of the power department is as follows:

A Babcock & Wilcox 52 horse-power boiler; A Harrison-Wharton 12 horse-power boiler; a 50 horse-power Brown engine, constructed specially for experimental investigation. It is steam jacketed, and has



DYNAMO ROOM, SCHOOL OF PRACTICAL SCIENCE, TORONTO.

ment as principal of the school, and the management thereof was entrusted to a council of which he was chairman.

The regular departments of instruction are five in number, viz: Civil engineering (including sanitary engineering), mining engineering, mechanical and electrical engineering, architecture, analytical and applied chemistry.

The regular course in each department is of three years' duration, at the completion of which the diploma of the school is granted to the student. The equipment of the school has been proceeded with year by year, and is now almost complete. There are the chemical, blow pipe, and assaying, stamp mill, electrical, meteorological, hydraulic, steam engine, and the testing of materials laboratories, in all of which the appliances are of a standard in keeping with the requirements of a first-class school.

We give herewith illustrations and some particulars of the engineering equipment, in which the readers of

three alternative exhausts to the open air, to a jet condenser, and to a Wheeler surface condenser—presented to the school by Mr. F. M. Wheeler of New York, the inventor. There are also a Blake circulating pump, a Knowles air pump and a Blake boiler feed pump (the latter being a gift from the manufacturers), and a machine for testing lubricating oils and measuring journal friction, built by Richie Bros., Philadelphia.

The hydraulic division is furnished with a three throw pump, having a capacity of 500,000 gallons per 24 hours. There are also large tanks furnished with orifices and weirs, measuring tanks, etc. A three feet jet turbine, a nine inch McCormick and a six inch New American turbine, the latter the gift of William Kennedy & Sons, of Owen Sound, are also included, together with the usual measuring instruments, indicators, gauges, gauge testing apparatus, scales, brakes and dynamometers. The shafting is driven by a 7 horse-power Otto gas engine, a 20 K.W. Edison motor, and a Brown engine.

Coming to the electrical laboratory, the first section is the engineering division, in which a 20 K.W. motor furnishes the power to drive several continuous current dynamos of constant potential and current, as well as an alternator. There are two motors of 6 and 3 h.p., besides several smaller motors, one of which is for alternating current. Recently there have been added a polyphase motor, and a rotary converter. On the walls, besides rheostats, are four types of transformers and meters for continuous and alternating currents. Arc lamps of seven types are hung around the laboratory, and incandescent lamps which may be used for the purposes of a rheostat. There are also a battery of Roberts storage cells and several chloride accumulators. A new switchboard is being constructed under the personal supervision of Mr. Rosebrugh, which, in addition to affording facility for inter-connection, will also carry measuring instruments which may be readily introduced into any circuit. A Thomson balance,

The electrical apparatus in connection with the University of Toronto, to which students have access also, includes electronometers, galvanometers, resistance coils and bridges, testing keys, batteries, electrical machines (Holz and Carre), Ruhmkorff coils, Crookes' tubes, telephones, etc.

Electricity has also been used to facilitate the study of the science of architecture, a powerful electrical stereopticon being employed for the illustration of designs.

In the mining department a six K.W. constant potential motor, supplied by 110 volt incandescent circuit of the city, and made by the Canadian General Electric Co., at Peterboro', is used for driving the machines for making tests of ore, etc.

In addition to taking the course of instruction in the school and passing the requisite examinations a candidate for the diploma in mechanical and electrical engineering is required to present satisfactory evidence



GALVANOMETER LABORATORY, SCHOOL OF PRACTICAL SCIENCE, TORONTO.

multicellular electrostatic voltmeter, and high potential electrostatic voltmeter, a Siemens' electro-dynamometer, and standard Weston measuring instruments furnish the means either of accurate observation or for standardization of instruments for ordinary use. These are generally used in a separate room, to which connection is made. The second section of the electrical laboratory is a room 24 by 49 feet, in another part of the basement, from which iron has as far as possible been removed. Here ten masonry piers support galvanometers, an electrometer, and other mirror reflecting instruments, and testing work can be done free from disturbing influences. Fume cupboards and sinks have been provided for work with galvanic and storage cells; the room is also supplied with Wheatstone bridges, Kohirausch apparatus for electrolytes, standard divided microfarad condenser, Clark cells and other apparatus. Wires leading from this room to the switchboard allow measurements to be made in connection with experiments in the other laboratory. Connections to the 110-volt circuit of the city are accessible in all the rooms.

of having had at least one year's good practical experience in one of the principal occupations connected with mechanical work, such as machinist, pattern-maker, moulder, steam engineer, etc. There is no restriction as to the place where the candidate may have gained such practical experience.

In connection with the school there is the Engineering Society, which is carried on by the students, with the approval and encouragement of the teachers.

The efforts of Prof. Galbraith, the Principal, to maintain the high standard of the school have met with much success, while the cost of its maintenance is said to be less than any similar institution. Mr. T. R. Rosebrugh, M.A., is lecturer in electrical engineering, assisted by Mr. A. E. Blackwood; Mr. J. A. Duff, B.A., is lecturer in applied mechanics, and Mr. W. Minty, B.A.Sc., in mechanical engineering.

The ratepayers of Alexandria, Ont., are moving in the direction of securing an electric railway from the Canada Atlantic depot to Green Valley, a distance of $4\frac{1}{2}$ miles.

THE ROMANCE OF THE TELEGRAPH.

THE December number of the Methodist Magazine contains an article under the above title by Marion Norma Brock, in which the fact is related that in China, when the telegraph line was built at Foochow, the people broke it every night, believing it would cast an evil spell over the country. They considered even the shadow of a pole falling across a tomb as a desecration, and as the graves in China are often in the private gardens, it was difficult to secure "way leaves," for neither love nor money would induce the Chinaman to tolerate this sacrilege. The natives of Senegal have a superstitious dread of what they call the "white man's talking-jumbo," and both line and linesmen are left unmolested. In Coomassie, the natives left the white man's wire alone after they had constructed a thread line of their own and so satisfied their self-respect.

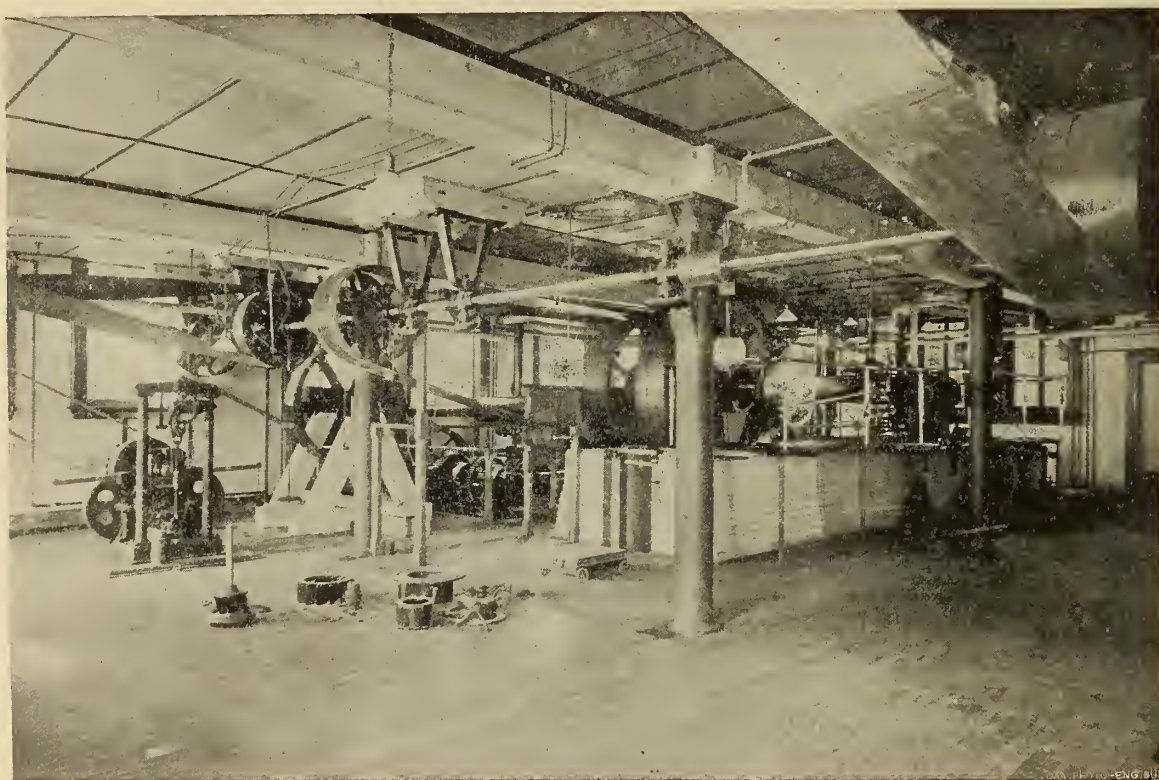
The writer of this article alludes to the vigorous

The bison, on the plains of the Great West, found the accommodating posts could be pleasantly used as currycombs. They were, however, not at all durable for this purpose, as the bison gave them vigorous usage. To protect the poles from such treatment, sharp iron spikes were driven into a large number of them. But this ingenious device did not work well, for the buffalos regarded the spikes as a great improvement to their currycombs, and chose the spiked poles every time in preference to the others.

RESIGNATION OF MR. RUTHERFORD.

MR. W. Rutherford, chief engineer of the Canadian General Electric Company, has resigned his position, to accept the management of the electric traction department, which is now being established by the well-known English engineering and contracting firm of Dick, Kerr & Company.

Mr. Rutherford's experience in mechanical and electrical engineering, gained first in Cardiff, Wales, then with the Thomson-Houston International Electric Company in South America and



EXPERIMENTAL ENGINE, SCHOOL OF PRACTICAL SCIENCE, TORONTO.

opposition to the land wires offered by the animal creation. We are told that in some parts of Norway, the lower part of the poles has to be protected in order to keep the bears from clawing them to pieces, under the supposition that the humming of the wires is the drone of insects within the posts. The large woodpecker of Norway and the green woodpecker of California, probably deceived in the same manner as the bears, bore myriads of holes in the posts. Our busy Canadian woodpecker appears to be more sagacious—at least his attacks on the telegraph pole have not been frequent enough to be anywhere recorded. In the tropics, the posts have been treated with creosote, where iron poles are not used, to prevent the destructive raids made by the white ants. Monkeys find the wires of the telegraph make delightful performing bars, and frequently use them in their gymnastic exercises, thus causing a serious leakage of the current. Mischief-loving elephants, in the glory of their strength, will occasionally perform the feat of levelling a dozen poles or more.

elsewhere, and finally since 1890 as chief engineer of the Toronto Construction and Electrical Supply Company and the Canadian General Electric Co., has been such as to render him eminently fitted for the important and responsible position which he is about to undertake. Practically the entire period of electric railway development in this country is covered by the five years which Mr. Rutherford has spent with the Canadian company, in his official connection with which he has had the supervision of the engineering features of the greater number of the important electric railway installations throughout the Dominion. The engineering firm of Dick, Kerr & Co. is one of the largest in Great Britain, their business as manufacturers of rails and general railway supplies being carried on in all parts of the world. In Canada they are principally known as selling agents for the Phenix steel rails, used on the Toronto and Montreal railway systems. That they should have considered the present an opportune moment for entering the electric railway field may be taken as establishing the fact that the long deferred development of electric traction in Great Britain has commenced in earnest. The ELECTRICAL NEWS, while regretting Mr. Rutherford's departure from the ranks of Canadian electrical engineers, feels at the same time bound to congratulate him on the enlarged scope of his future work, and Messrs Dick, Kerr & Company on having secured the right man for the right place.

CORRESPONDENCE

AN ELECTRICAL LABORATORY.

MONTREAL, December 10th, 1896.

To the Editor of the CANADIAN ELECTRICAL NEWS.

SIR,—In reading over the CANADIAN ELECTRICAL NEWS for the month of December I noticed a paragraph headed "Electrical Progress."

Your suggestion that a central station laboratory under competent direction should be established, in which all sorts of tests could be made is a valuable one. Let me state, however, that in our electrical department of McGill University such a laboratory already exists, in which we have been carrying out practical tests on transformers, arc lamps, dynamos, etc., for manufacturing establishments. The laboratory is very fully and completely equipped for carrying on such tests, but, strange to say, the greater part of our work has come from the United States. We should, however, be very pleased to carry out similar work for Canadian firms.

Yours truly,

HENRY T. BOVEY.

INFORMATION WANTED.

SCOTSTOWN, P. Q., Dec. 16th, 1896.

To the Editor of the CANADIAN ELECTRICAL NEWS.

SIR,—I wish to transmit about eight horse power a distance of about 1,500 feet from a water wheel, which I can do by using an electric motor, but that is expensive.

I have been thinking that I could connect an air compressor directly to the water wheel and carry the air in steam pipes to the place where the power is required, and use an ordinary steam engine. There is only one difficulty I see in the way, that is, to keep the engine from heating. Perhaps some of your readers have had experience with this kind of power, and can give me some light on the subject through the columns of THE NEWS.

Yours truly,

C. H. PARKER.

[It is perfectly feasible to transmit the power by means of a compressor and a steam engine as you propose. There is no difficulty about the heating. The cylinder of course would need oiling, but the principal difficulty that has been found has not been the heating but the cooling, as the air expands when released from the engine and usually produces frost. The method of transmission by compressed air has a good deal to be said in its favor, but in this individual case we are of the opinion that the cost of the apparatus, namely, the compressor and the engine, would be considerably more than the cost of the electric outfit.—ED. NEWS.]

ONTARIO ASSOCIATION STATIONARY ENGINEERS.

TORONTO, Dec. 21, 1896.

To the Editor of the CANADIAN ELECTRICAL NEWS.

DEAR SIR,—Since the first of November thirty-seven engineers have been examined by the O. A. S. E. Examining Board, and thirty were successful and received certificates.

The city council have lately passed a resolution providing that every engineer in the city's employ must hold at least a third class O. A. S. E. certificate, and

the Hamilton School Board have passed a similar resolution in regard to the caretakers of all their public schools. The city council of St. Thomas is at the time of writing considering the advisability of passing a by-law to provide that all men in charge of steam boilers in that city be required to hold certificates of competence.

During the past two months several manufacturing concerns have required engineers and have refused to entertain the application of any engineer who did not hold a stationary engineer's certificate. This is quite natural as things are, for the only proof the steam user can get, that an engineer has a knowledge of his work, is the fact that he has passed a practical examination and has a certificate of qualification. Of course, the fact that a man holds a certificate does not prove that he will not be careless, lazy or indifferent to his employer's interest, but it is proof that he has a knowledge of his duties as an engineer, and that he has (up to the time of examination) been steady and sober.

It is the intention of the C. A. S. E. and the O. A. S. E. combined to again introduce a measure before the coming parliament to provide for the qualification of all engineers in charge of stationary steam boilers and engines.

Any engineer desiring information regarding examinations under the present act will receive a copy of same and by-laws on receipt of a post card asking for same and giving name and address.

Yours truly,

ALBERT E. EDKINS, Registrar.

Office, 88 Caroline St., Toronto.

THE YOUNG MAN'S CHANCES IN THE ELECTRICAL FIELD.

THE following opinion by Mr. Chas. B. Hunt, Manager of the London Electric Co., was received too late to be incorporated in the symposium on the above subject published in THE ELECTRICAL NEWS for December :

"In reply to your enquiry I beg to say that I believe the opportunities for young men who graduate as electrical engineers are many, and will increase yearly as the different branches become more perfected, particularly in connection with all central stations, street railroads and other electrical establishments.

"As you are aware, a great deal of the electric current losses are caused by a want of knowledge of the proper construction of the lines, and distribution of same.

"Unless the manager, superintendent or foreman of companies are competent, and know the carrying capacity of wires at all distances, the resistance of the different kinds of metal used, the interior construction of every part of the generating machinery, including boilers, engines, dynamos, also transformers and meters, it is impossible for a company to know why they are not making money, or to locate the trouble.

"I therefore, believe that in a few years all important positions in connection with electric lighting stations, electric street railroads and electric manufacturing establishments will be filled by graduates from our different electrical colleges, and as fast as vacancies occur in the older stations, young graduates will be taken in to fill same. But like any other profession, they must not expect to receive large salaries until they have proved themselves capable and worthy of them."

SPARKS.

The 15 year old son of Wm. Cruse was killed in Kingston by an electric car.

Geo. Alexander has been granted a franchise for electric lighting at Kaslo, B. C.

The Hull Electric Co. will place an additional dynamo at the power house, Deschenes Mills.

Parrsboro, N. S., will probably be lighted by electricity. The question of purchasing a plant is now under consideration by the town.

It is said that Greenwood, Ont., will shortly be lighted by electricity. It is intended to utilize the water power in the neighborhood.

The annual meeting of the shareholders of the Toronto Street Railway Company will be held in Toronto on the 20th of this month.

The West Kootenay Power and Light Company and the Kootenay Power and Light Company, of Kootenay, B. C., are seeking incorporation.

Messrs. Plewes & Spence, of Creemore, Ont., have secured the contract of lighting the streets of Colborne, and will put in an electric light plant.

A new 7,000 light dynamo has recently been placed in No. 5 power house of the Ottawa Electric Co. This dynamo replaces eight 750-light machines.

An action was brought by Mr. Easton to recover \$60,000 damages from the Brantford Street Railway Company for injuries received in an accident, by which he has become paralyzed. A verdict for \$12,000 has been given.

A company in which Mayor Elliott, of Brantford, is interested, propose building an electric railway from Brantford to Ayr, via Paris, and another from Brantford to Port Dover. The city of Brantford will be asked to grant a bonus.

It is reported that on condition that the Dominion Government will assist, the Grand Trunk Railway Co. have offered to convert the Victoria Bridge at Montreal into a double-track structure, with an additional track for a trolley service.

The whole of the lines of the Consolidated Railway & Light Company, of Vancouver, B. C., were offered for sale by auction by Mr. W. H. Hooper by order of the Yorkshire Guarantee & Securities Company, trustees for the bondholders, but no offers were received.

The Hull Electric Co. are busy building their double track between Aylmer and Hull. When the road is reballasted in the spring and the double track finished into Aylmer, Mr. Spencer asserts that the run will be made in fifteen minutes or at a rate of about forty miles an hour.

James Best has begun an action against the Hamilton Street Railway Company for damages for being put off a street car after having dropped a punched 5 cent piece in the fare box. The conductor, he alleges, refused to allow him to ride to his destination unless he paid the second time therefor, the coin with a hole in it not being acceptable.

The Superintendent of the Government Telegraphic Service is engaged in preparing for the extension of telegraph lines from Esquimaux Point, Que., the present easterly terminus of the line on the north shore of the gulf, to Belle Isle. In the course of the next year it is expected to add about 80 miles of line, which will carry the wires as far as Natishquan, 666 miles below Quebec.

The city council of Halifax are not satisfied with the service supplied by the street railway company, and resolutions have been adopted authorizing that legal proceedings be taken if in thirty days the company do not furnish the council with time table and scale of fees and system of transfers. The city engineer has also been instructed to report on the cost of an electric light plant to be controlled by the city.

A charter has been granted to the British Columbia Tunneling and Development Company, Limited, of Rossland. The purpose of the company is to construct a tunnel through Red mountain, and to construct double tracks on which it is proposed to operate electric cars to convey ore from the different mines. The projectors of the undertaking are J. F. McLaughlin, W. A. Campbell, and John J. Moynahan, and Col. Frank Moberley is preparing estimates of the work.

The new combined passenger, baggage and mail car now being constructed for the Ottawa Electric Railway will shortly be completed. It will be a fine piece of workmanship. The interior will

be finished in polished oak and beautifully carved and the windows in the passenger portion will be of plate glass. The length of the car will be 28 feet. The compartment for passengers will be at one end, the baggage room in the centre, and the mail matter room at the other end.

It is reported that a company has been organized in Philadelphia to promote a system of gold mining without removing the ore from the earth. The scheme is to sink shafts a few inches apart and pump into them a suitable dissolvent. A strong electric current is then to be passed through the soil between the shafts. The action of the electric current is claimed to be that it will carry with it the dissolved gold from one shaft to the other and deposit it there on any metallic circuit in the same manner as electro-plating.

The Toronto Radial Railway Company is seeking incorporation from the Ontario Legislature to acquire the franchise and property of the Toronto Belt Line Railway Company, or any other company operating or having the right to operate an electric or other railway in the city of Toronto, or within fifty miles thereof. The company propose to convert into an electric road the steam railway which was constructed around Toronto some years ago by the Grand Trunk Railway. Messrs. Mercer, Bradford & Titus are acting as solicitors.

Mr. James Hill, of Cleveland, Ohio, has just completed the construction of a chimney for the St. John (N. B.) Electric Railway Company, which is the third largest in Canada. The chimney is 177 feet in height from the ground and goes beneath the ground 32 feet, where it rests on a solid rock foundation. It contains, approximately 400,000 brick. The foundation is 18 feet square, and this exterior size is preserved to a height of 40 feet above the ground. From that point up it is rounded and below the top it narrows to 10 feet 6 inches, swelling out to 12 feet nine inches at the top.

The transmission of electric current from Newcastle to Sacramento, Cal., has been successfully performed. The distance is thirty miles. Three high potential wires carry the current from the power house to the station, which is furnished with two motors and two arc light dynamos, which run 120 arc lights. It has also eight step-down transformers to reduce the voltage, and the switchboard is furnished with several of the latest improvements. A current of 15,000 volts was turned on at Newcastle to test the line, and it was found to be in perfect order when reaching Sacramento.

There is an engine built 150 years ago, which is said to be still in use in a coal mine in England, doing duty five hours a day. It pumps water from a shaft 750 feet deep. The engine is considered to be the oldest steam user in the world, being built by a blacksmith named Newcomen. The engine works at a pressure of two and a half pounds to the square inch, giving a little over fifty horse power. Its weight is about 600 pounds. The cylinder is five and a half feet in diameter with a six foot stroke. The walking beam is of oak. The father and grandfather of the present engineer preceded him at the post of operating the Adam of all steam engines, so that three generations have had the honor of operating the ancient piece of machinery.

The waterworks and electric light systems of the corporation of Sudbury were successfully started a few days ago. They are operating from their alternating current two-phase dynamo, furnished by the Royal Electric Co. of Montreal, over 1000 16 c. p. incandescent lamps, 16 street arc lamps of the Helios type of 2000 c. p. each, and a number of small motors driving printing presses, meat choppers, etc. The power house, in which are erected the pumps as well as the electric light and steam power, is a solid brick structure 2½ stories high in the main part, with a boiler room extension, solid stone basement, cement and hardwood floors, and situated close to the lake on property bought for the purpose. The plant consists of two boilers of 60 h. p. each, made by Jenckes, of Sherbrooke, two Northey duplex pumps with a capacity of 30,000 gallons per hour, one 125 h. p. Wheelock automatic engine with condenser, one 75 k.w. "S.K.C." generator, with station apparatus complete. The water is forced by the pumps into a steel tank built on a steel tower, which holds 70,000 gallons. The elevation of the tower gives 82 lbs. pressure at the hydrants, which is ample to put a fire stream over the highest building in the town. The city fathers and the people in general are highly pleased with the entire plant and much credit is due to the engineers, Messrs. J. R. Gordon, C. E., and L. Y. Rorke, D. L. S., for the first-class manner in which this second and new plant was installed.

MOONLIGHT SCHEDULE FOR JANUARY.

Day of Month.	Light.	Extinguish.	No. of Hours.
	H.M.	H.M.	H.M.
1.....	P. M. 5.15	A. M. 6.25	13.10
2.....	" 5.15	" 6.25	13.10
3.....	" 5.15	" 6.25	13.10
4.....	" 5.30	" 6.25	12.55
5.....	" 6.00	" 6.25	12.25
6.....	" 6.50	" 6.25	11.35
7.....	" 8.00	" 6.25	10.25
8.....	" 9.10	" 6.25	9.15
9.....	" 10.30	" 6.20	7.50
10.....	" 11.30	" 6.20	6.50
11.....	" .....	.....	5.50
12.....	A.M. 12.30	" 6.20	4.40
13.....	" 1.40	" 6.20	3.20
14.....	" 3.00	" 6.20	2.20
15.....	" 4.00	" 6.20	.....
16.....	No light.	No light.	.....
17.....	No light.	No light.	.....
18.....	No light.	No light.	.....
19.....	No light.	No light.	.....
20.....	P. M. 5.30	P. M. 8.30	4.10
21.....	" 5.30	" 9.40	4.10
22.....	" 5.30	" 9.40	5.30
23.....	" 5.30	" 11.00	6.30
24.....	" 5.30	" 12.00	8.00
25.....	" 5.30	A. M. 1.30	9.25
26.....	" 5.35	" 3.00	10.35
27.....	" 5.35	" 4.10	11.55
28.....	" 5.35	" 5.30	12.35
29.....	" 5.35	" 6.10	12.35
30.....	" 5.35	" 6.10	12.35
31.....	" 5.35	" 6.10	12.35
Total,			227.55

TRADE NOTES.

It is said to be the intention of the Canadian Pacific Ry. Co. to substitute mica and wool for the wooden covering which has hitherto been used on their locomotive boilers.

Beginning with the new year the name of the well-known manufacturers of leather belting, Messrs. Robin, Sadler & Haworth, was changed to "Sadler & Haworth." With this change the business will be conducted exactly as before.

Mr. R. E. T. Pringle, Montreal, agent for the Packard Electric Co., Ltd., of St. Catharines, Ont., has recently opened a large store at No. 216 St. James St., Montreal. Mr. Pringle's largely increased business has necessitated this, and he is fortunate in having one of the best located electrical stores in Montreal.

The Royal Electric Co. are installing an electric lighting plant for Wm. Irving, of Sundridge. They are furnishing one of their latest type two-phase "S.K.C." 25 k. w. dynamos. Contracts have already been secured for about 200 lights, and also for one motor to run off the same two-phase alternating circuit.

The Consolidated Milling Co., of Peterboro, are having their large mills lighted by electricity. The Royal Electric Co. is furnishing the dynamo and material, and Mr. J. H. Greer, of Peterboro, is installing the plant. The Consolidated Milling Co. expect to run about 24 hours per day, from which it would appear that they have plenty of business in view.

We are advised that as the result of their rapidly increasing business the Packard Electric Co., of St. Catharines, will shortly be compelled to double the capacity of their plant for the manufacture of lamps and transformers. They report having brought their transformers up to the highest stage of efficiency, and that they are finding excellent sale for their Scheffer watt meters.

The Dodge Wood Split Pulley Company, of 74 York street, Toronto, are now offering for immediate delivery high grade turned and polished steel shafting in any diameter and in any length up to 24 feet each; new designs in either compression, grim-death or flange couplings; hangers of all kinds, any drop, of latest style, adjustable in all directions, with either plain bearings or the Dodge Company's new patent capillary self-oiling bearings. This is positively claimed to be the most up-to-date line of power transmission appliances on the market, and manufacturers and others using shafting, hangers, pulleys, clutches, etc., will do well to get the company's prices when in want.

The Brantford Electric & Operating Co. have purchased from the Royal Electric Co., of Montreal, and now have in operation in their station, a 150 k. w. "S.K.C." two-phase alternating current dynamo. This company had a number of serious misfortunes with its lighting apparatus, and desired a new machine delivered there quickly. The order was given to the Royal Electric Co., of Montreal, on December 5th at 5 p.m., and on Friday, December 11th, the dynamo was furnishing light to the city of Brantford. It was ready for operation in a little more than five days after the order was given. It was set up in running order in the factory of the Royal Electric Co., in Montreal, had to be dismantled and boxed, shipped to Brantford and there unboxed and put together again, set on foundations and connected to the old systems. The time of transit was from 6 p.m. Monday, until 12 noon, Thursday. The balance of the time was consumed in dismantling and boxing

at Montreal and unboxing and setting up in Brantford. It is the intention of the Brantford Electric & Operating Co. in future to furnish power from the two-phase system. In this they are following the lead of a number of the best companies in Canada. This "S.K.C." dynamo was purchased under the new management of the Brantford Electric & Operating Co., and shows unmistakably that they are prepared to remain in the front rank of the electrical business.

SPARKS.

An addition is being built to the works of the Montmorency Electric Co., Montmorency Falls, Que.

The employees of the Ottawa Electric Light Co. lately presented Mr. W. G. Bradley, superintendent of construction of arc lights, with a beautiful gold locket.

The Thompson Electric Co., formerly of Waterford, Ont., will remove to Hamilton, where they have secured the large Wanzer premises and will continue the manufacture of dynamos, arc lamps, and other electrical apparatus.

The city council of Chatham, Ont., are wrestling with the question of street lighting, and a by-law will probably be submitted to provide the sum of \$15,000 to purchase an electric light plant. The cost under the present arrangement is \$65.80 per lamp of 2,000 c. p.

The Kingston, Portsmouth and Cataraqui Street Railway Company have assumed control of the plant of the Kingston Light, Heat and Power Company, the lease being extended over five years. The last mentioned company controlled the gas and electric light plants.

The bold enterprise shown by Canadians fairly takes a New York contemporary's breath away. The Electrical Review expresses its astonishment thus: "The Keewatin Power Company is making contracts to supply electric power in Winnipeg, Manitoba, transmitted a distance of 130 miles. Whew!"

Mr. F. W. Simmons, electrician for the Kingston Light, Heat and Power Company, has invented an operative arc lamp intended chiefly for use in theatres. It can be used either on an alternating or continuous current from 800 to 3,000 candle power, focussing electric rays from a four foot radius to eighty foot area.

Two tenders were received by the Toronto City Council for a telephone franchise. Mr. Geo. Musson, on behalf of the Automatic Telephone Co., offered to supply office telephones at \$36 per annum, and houses at \$20, and to pay a percentage to the city of 6 per cent. on gross earnings. The offer of Mr. James Curry, acting for the Wilhelm telephone system of Buffalo, was for a ten-year renewable term, and the price \$32.50 for offices and \$18.50 for residences. No action by the council has yet been taken.

The Hanover Electric Light and Power Co. have a neat electric plant at Hanover, Ont. The power used is supplied through an 81 h.p. "Kennedy" and a 71 h.p. "Barber" water wheel, developing from 275 to 300 h.p. In the power house are a 25 arc light machine, and a 1,500 incandescent light machine furnished by the Canadian General Electric Co. Besides Hanover, the villages of Carlsruhe and Neustadt are lighted from the plant, while requests for light have been made from other municipalities. Mr. Wm. Knechtel has charge of the power house, and Messrs. D. and Joshua Knechtel comprise the company.

The first case of alleged fraud with electric light meters was brought to the attention of Mr. Johnson, the Divisional Inspector of Electric Light, while in town yesterday. The meter in question had been so tampered with that it did not register, and hence the light was used without the amount of electricity consumed being recorded, and therefore with no means of ascertaining the amount that should be paid. The penalty for an offence of this kind is a fine from \$50 to \$100. Mr. Johnson has the facts before him and will decide as to what is the best course of action to pursue in the matter.—Peterborough Review.

At the annual meeting of the Montreal Park and Island Railway Company, held last month, a satisfactory report was presented, dealing with the last year's operations, and referring in hopeful terms to the work contemplated for 1897. The new board of directors was also elected as follows: Hon. J. R. Thibeadeau, Hon. Louis Beaubien, Mr. D. Morrice, Mr. H. Holt, Hon. Alfred A. Thibeadeau, Mr. W. Strachan and Mr. W. J. Morrice. At the first meeting of the newly-elected directors Mr. Herbert Holt was unanimously elected president; Hon. J. R. Thibeadeau, vice-president; Mr. Wm. Strachan, treasurer, and Mr. Hy. Holgate, secretary and manager. The company's new extension to Cartierville, three and a half miles distant from St. Laurent, and six and a half miles from the Cote St. Luc road, has been completed. Several new cars have been received from the manufacturers, the Rathbun Company, of Deseronto.

It is reported that the promoters of a large gold mine in Australia have placed an order with a California firm for a large auto-motor car for conveying supplies to the mine, located about 400 miles distant. The car will be equipped with a motor of seventy-five horse power, and will be driven by petroleum. It will be run over one of the worst stretches of desert in the world, where it is impossible to obtain either food for men or water for the automobile "beast of burden." The consequence of this is that the steam used for propulsion will have to be condensed and used over and over again. To meet this difficulty it has been arranged to place 1,000 feet of piping as a roof over the car. The piping will act as a condenser, the steam having ample time to cool in passing through its long length. The estimated speed at which the car will be run is between four and eight miles an hour, and its carrying capacity is fifteen tons.

ELECTRIC RAILWAY DEPARTMENT.

PROPOSED ISLAND STREET CAR SYSTEM.

THE Toronto Street Railway Company have made a proposition to the City Council of Toronto to extend the street railway system to the island by means of a bridge extending across the bay. With a view to obtaining the estimated cost of the undertaking a report was prepared by the City Engineer, who also furnished the accompanying map showing the proposed route. Commencing at the corner of King and Bathurst streets, railway tracks would be constructed down Bathurst

concrete foundations, at \$59,374; No. 3, including the construction of an avenue 80 feet wide and two 12 foot plank sidewalks on each side of roadway, also a double line of street railway tracks in the centre, rails laid on concrete, is given as \$187,131. The total cost of the work under the three estimates would be \$144,987, \$164,094 and \$191,851. Should the extension be carried out, the road would no doubt be largely patronized during the summer season.

A scheme is on foot to amalgamate all the electric railways in and around Hamilton, in which case the Hamilton and Dundas



street to the Queen's wharf. This would entail the erection of a new bridge crossing the present railway tracks south of Front street. The line would continue down the roadway to the western channel, over which it is proposed to construct a swing bridge. The cost of the work thus far, including the bridges, is given as \$104,720. The swing bridge would cost \$61,000 and the bridge over the railway tracks \$20,000. Southerly from the Queen's wharf the proposed line will run along the sand bar, crossing the lagoon into what was formerly known as Heber's lot, then south in rear of cottages, crossing the waterworks cut north of the light house, thence easterly to Ward's island. Three estimates have been prepared of the cost of the island portion of the scheme. No. 1, for a 22 foot embankment for railway tracks, exclusive of concrete foundations under rails, places the cost at \$40,267; No. 2, including

Railway will be converted into an electric road and extended to Galt. Mr. B. B. Osler is said to be at the head of the movement.

A neat little calendar has been received, with the compliments of the Eugene F. Philips Electrical Works, Montreal.

At the annual meeting of the Hamilton Street Railway Company Mr. William Gibson, M.P., was elected president, Mr. B. E. Charlton having retired. In addition to the president, the directors are: Messrs. B. E. Charlton, Edward Martin, Q. C., Isaiah Beer, W. J. Harris, F. W. Fearman and John A. Bruce.

Mr. W. Y. Soper, of the Ottawa Electric Railway Company, introduced an attractive novelty in that city on Christmas eve. Santa Claus appeared on top of an electric car driving a reindeer and distributed gifts to the boys and girls on the street. The car, decorated in Christmas fashion, was filled with fruit and candy.

The earnings of the Toronto Street Railway during the year 1896 were \$986,501.37. The following is a statement of earnings by months: January, \$74,266.50; February, \$74,155.76; March, \$74,409.63; May, \$83,004.13; June, \$85,175.13; July, \$87,761.37; August, \$86,103.92; September, \$106,529.57; October, \$78,343.49; November, \$76,145.73; December, \$84,310.38.

HURON AND ONTARIO ELECTRIC RAILWAY.

It is probable that the year 1897 will witness the construction of the longest electric railway in Canada, if not in America, namely, the Huron and Ontario Electric Railway. About a year ago a number of persons in Western Ontario were granted incorporation by the Dominion government as the Huron and Ontario Railway Company, the objects being to construct a railway from Port Perry westerly to Lake Huron, thereby intersecting several existing railways. The capital stock was placed at \$2,000,000, and to assist in construction the company were given power to issue bonds to the extent of \$10,000 per mile of railway, and \$6,000 additional for each mile double-tracked.

The first regular meeting of the directors was held in Toronto in May last, at which Mr. M. McNamara, of Walkerton, was elected president, H. J. Rolston, of Shelburne, vice-president, A. McK. Cameron, of Meaford, secretary, and J. M. Roberts, of Dungannon, treasurer. The second meeting was held a month later. The route of the proposed road was considered, and it was stated that negotiations had been entered into with Messrs. Miller Bros., of New York, to undertake the construction of the road. At a meeting in July, Mr. A. Brunel, C. E., was instructed to prepare a profile of the proposed route, together with a statement of the available water power and probable cost. The report was presented on August 27th, according to which the road will be 285 miles in length. The accompanying map will show the proposed route. The report divides the road into seven sections, as follows:

Port Perry to Beeton.—This line is 52 miles in length, and passes through several towns and villages. There are a number of culverts along the route, as well as several bridges, but none of them are very large. On this division there is no water power of any importance, and steam power will probably be used for the eastern portion of it.

Beeton to Flesherton.—The length of this section is 64 miles, but the road is somewhat level all the way and no engineering difficulties are likely to be encountered. The line crosses the Grand Trunk Railway three times. The first water power available is situated at Thompsonville, seven miles north of Beeton, which, with improvements, would give from 300 to 400 horse power. The dam, building and flume is estimated to cost \$8,000. At Eugenia the Beaver river has a descent of 64 feet in a distance of 2,000 feet, where there are at present four good water powers. About 1,000 horse power could be developed, while the falls below would provide a corresponding amount. Below the falls the river drops 220 feet, which would furnish a large amount of power. The basement of the Wilson factory could be converted into a power house at a small expense. In addition to the cost of the electric plant, the cost of the work is given as \$6,500.

Flesherton to Walkerton.—The distance between these two points is 37 miles. The bridging is heavy on this section, there being several large bridges over the Saugeen river. There is a water power on the Saugeen river, two miles west of Durham, which would supply 500 horse power at a cost of \$7,000.

Walkerton to Tiverton, via Kincardine.—This section is 37 miles in length, and will require the construction of a number of small bridges and culverts. The grading would not exceed the maximum of ten per cent. at any point. There are a large number of bridges, including one of 100 feet span. No report is furnished by the engineer on the water power in this district.

Walkerton to Goderich.—Between these two points the road would be 55 miles in length. From Formosa to Teeswater there would be three 60-foot and two 15-foot bridges, besides other culverts. The Grand Trunk, Canadian Pacific, and W. G. & B. division of the G. T. R. are crossed at various points. The Maitland river will be crossed by a large bridge of three spans of

145 feet each. About 200 horse power may be obtained about a half mile west of Dungannon, and on the Maitland river near Goderich there is a good site for power, capable of developing 800 horse power. The cost for dam and buildings would be from \$12,000 to \$15,000.

Bervie to Lucknow.—The shortest section is between these two points, the distance being 15 miles. It is proposed to connect the line to Kincardine at a point near Bervie with the Goderich line at Lucknow, by way of Ripley and Holyrood.

The rolling stock required for each division will be two motor cars and four trailers for passengers, mail and express, and one heavy freight motor, which would



PROPOSED ROUTE OF THE HURON AND ONTARIO RAILWAY.

give for the six divisions 12 motor cars, 24 trailers and 6 freight motors for the whole line.

The company have for some time been negotiating with Messrs. Miller Bros., of New York, to arrange for carrying out the undertaking, and it is said that an agreement has been reached with Mr. Moore, a wealthy contractor of that city, to undertake the work of construction, which they hope to have completed by the 1st of January, 1898. The total estimated cost is between four and five million dollars, and the contracts for electrical equipment, etc., will likely be awarded in the spring.

TORONTO STREET RAILWAY ASSESSMENT CASE.

THE decision in the appeal case of the Toronto Street Railway Company vs. the City of Toronto was given late in November last, and reverses the decision of the Court of Appeal confirming the assessment of \$537,137 upon the rails, poles and wires of the company. According to the decision, these are declared non-assessable. Below will be found the full text of the decision of the three judges, Messrs. J. Darnell, J. McGibbon and J. McDougall:

McGIBBON, J.:—This is an appeal from the decision of the Court of Revision for the municipality of the city of Toronto to three judges under the provisions of the Consolidated Assessment Act of 1892 and amending Act, in respect of the Appellant's property, consisting of rails, poles and wires.

The Company contend that they were improperly assessed for \$537,137 in respect of the said property. The assessment of the Appellants for 1897 is \$563,403, and it is conceded that part of that sum, namely, \$537,137, was for rails, poles and wires of the said company. The assessment was confirmed by the Court of Revision. The question submitted for our consideration is, are these rails, poles and wires rateable property within the meaning of the Consolidated Assessment Act of 1892?

The Appellants contend that it was either personal property and exempt from taxation under section 34, sub-section 2, of the Consolidated Assessment Act—or if not personal property, was not land, real property or real estate, taxable as such within the meaning of that Act, being merely rails laid in and forming part of the streets and highways, and wires affixed to the said poles, and therefore exempt under section 7, sub-section 6, of the said act.

The classes of property mentioned in the said act, liable to assessment, are: first, land, real property and real estate, and second, personal property and personal estate.

After careful consideration of the law of assessment, I have come to the conclusion that the expressions land, real property and real estate, are synonymous terms, and that the only classes of property liable to assessment are lands and personal property, and the personal property of a railway company is exempt under section 34, ss. 2, of the said Assessment Act. The only remaining question to be considered is, "Are these rails, poles and wires land, real property or real estate, and liable to assessment as buildings erected to the buildings on the land assessed or the machinery affixed?"

It cannot be contended that either the rails, poles or wires are real estate, but only become so when they become affixed to the land and form a part thereof, and would be saleable under a tax deed for arrears of taxes.

In the case of Toronto Street Railway Company v. Fleming, 37 U. C. R. 116, Patterson, J. A., page 127, says, "the property of these defendants is only land as being part of the public street." The streets

remain "public streets" if the soil of the streets is exempt; I find nothing in the Act to say that that portion of it is not exempt which is occupied by the Plaintiff's railway while still remaining a part of the public road.

In my opinion the rails, poles and wires are not buildings erected upon or affixed to the land of the company, or machinery or other things affixed to any building erected on the said land under sub-section 9, section 2, of the said Act. The rails are laid on and fastened to the superstructure which is attached to the road or street, and are in no way attached to the land, real property or real estate of the company; so likewise are the poles and wires.

If the rails, poles and wires are attached to any land, they are attached to the roadway or street and form part of the same, and therefore exempt under section 7, sub-section 6, of the Consolidated Assessment Act.

It is contended by the Respondents that the Appellants are occupants of the street, and their property, therefore, liable to taxation. I do not think the Appellants have such an occupancy independently from the Respondents as to say that the Respondents have parted with their official occupancy and given it to the Appellants, and that the Appellants are liable to be taxed for the said streets under the said sub-section 2 of section 7 of the Assessment Act. The Respondents do not part with the occupancy of the streets, but retain possession of the same, merely granting to the Appellants certain rights and privileges, and the Appellants cannot be considered the occupants under section 2 of section 7, and liable to assessment. The streets remain the property of the Crown under the jurisdiction of the municipality, and they are exempt from taxation, as also are the rails, poles and wires of the Appellants when affixed to the said streets; ss. 1 of section 7 of the Assessment Act.

I do not think the decisions in the English rating cases are applicable to the present case. The difference in principle is shown in the judgment of Burton and Patterson, J. J. A., and in the case of the Toronto Street Railway Company v. Fleming, 37 U. C. R. 116. I do not consider the assessment law has been materially changed since the decision in the Fleming case so as to affect this case. The sections are now, with the exception of a few trifling verbal changes, the same as they were when the Fleming case was decided. I cannot distinguish this case from the Fleming case, in which it was held that the railway company was not assessable for these portions of the streets occupied by them for the purpose of their railway, as being land within the meaning of the Assessment Act of 1869. This case is distinguished from the Consumers' Gas Co. v. Toronto in that the pipes and mains of the gas company were laid in the city streets and attached to the plant and buildings of the company, whereas, in the case under consideration, the rails, poles and wires are in no way connected with the power house, plant or building of the Appellants' company.

I hold this case to be covered by the decision in the Fleming case, and would therefore allow the appeal with costs.

I am well satisfied to arrive at this conclusion because, the city and the company entered into their agreement, 55 Vic., Chap. 99, on the faith of the law settled by the Court of Error and Appeal in the Fleming case, and it would be, in my opinion, inequitable for the city by an assessment of the railway in the streets of the city, to increase the liability of the Railway Company under the agreement.

DARTNELL, J.:—The matters in question before us are of the highest interest and importance to the parties concerned, and require the most careful consideration. There are no contested facts in dispute, no evidence having been offered, and such facts as are necessary for consideration are fully set out in the arguments of counsel for each side, and the documents, papers and authorities submitted to us.

What we have to consider is whether, under all the circumstances submitted to us, is the Toronto Street Railway Co., for the remaining 25 years of this franchise, liable to taxation in respect of their rails, poles and wires erected and being upon the city of Toronto. It is conceded that for the first time since the agreement between the city and the company entered into some five years ago, and which has received legislative sanction, the city has undertaken to assess the company for the property now in question, and which has heretofore escaped taxation. It is also considered that such a taxation for such 25 years will amount to a sum aggregating in the whole to about \$200,000.

The city, apparently acting on the assumption or belief that the case in the Court of Appeal of the city of Toronto and the Consumers' Gas Co. has practically modified, distinguished or overruled the case of Fleming vs. Toronto Street Railway, conceived that the latter case was no longer binding upon them, and undertook for the first time to impose a rate upon the property of the company, now the subject of appeal.

These two judgments leave the state of the law in a somewhat unsatisfactory condition, arising from the fact that the judgments of the members of the Courts are not unanimous, and those judges who have arrived at conclusions which unitedly are the framework of the decision of the Court, have reached such conclusions by devious ways.

Since the case of Fleming vs. Toronto Street Railway has been decided, the verbiage of the Assessment Act has been altered, and, in that respect, the authority of that case as applied to the question before us is somewhat weakened. But for this, I should be inclined to hold that we were concluded by that case, and should without question allow the company's appeal.

I humbly conceive that there is a marked difference between the position of the gas company and the railway company. The former company is essentially a commercial corporation having an article of commerce to dispose of, which has been ranked in our courts as a "mineral," which can only be distributed to the company's customers through pipes connected with their main works and the storage reservoirs containing the commodity they sell. The general public have no interests in the works at all analogous to the use of the public highway and can at will put an end to the contracts made with their customers, subject, of course, to the ordinary rules governing all contracts. The railway company, on the other hand, offer to the city an improved and convenient method of utilizing the highways of the corporation, and undertake to do for the city what the city itself has power to do without their intervention. The city has surrendered to them certain portions of the surface of the city highways, for the greater ease of the propulsion of their vehicles, giving them the legal right of way over other vehicles,

and the right of exacting toll from the passengers using such vehicles, and exacting as the price of such concessions a mileage rental or assessment and a percentage of the gross profits of the company. They are common carriers, and are bound to receive all passengers presenting themselves for carriage and to keep in constant good condition their whole system. They also perform other services for the city, such as street watering and the conveyance and dumping of city garbage and refuse. In these respects the positions of the gas company and the railway company are essentially different. I am clearly of opinion that the relationship between the city and the company is not that of landlord and tenant. It is rather that of licensor and licensee. In fact the agreement between the parties ratified by legislation explicitly treats and styles them as "vendors" and "purchasers." No weight whatever can be given to this argument.

Neither do I think that this railway can be treated as a railway company in the sense that the C. P. R. or the G. T. R., or any railway incorporated under Dominion or Provincial authority can be classed as such, and entitled to exemption from taxation in respect of their rails as part of their superstructure. They have never taken that position until now.

I have carefully considered the discussion, arguments and judgment in the case before the Privy Council of the Queen vs. the Toronto Street Railway. I do not consider that the effect of that judgment is to declare that the latter is a "railway" in the sense that a Dominion or Provincial railway is a railway. It simply decides that certain rails imported for use and to be laid on the company's "railway track" and being over a certain weight, were exempt from customs duty.

I have had the advantage of the perusal of my brother McDougall's able and exhaustive judgment. He has so fully gone into the historical part of the subject, and so fully collected and set forth all the authorities bearing upon the matter, that it would be superfluous on my part to endeavor to supplement his remarks, even if I were able to do so. I may be permitted to remark that the English authorities, however instructive and illustrative, are not altogether binding upon us, inasmuch as the method of rating in England for the purposes of taxation is essentially different from our own. There the question before the courts is "Is this a bona fide occupancy?" and the occupant is rated. In Ontario the property is rated and is primarily liable. The question of ownership is entirely subsidiary.

I agree with my brother McDougall that the poles and wires of the company are governed by the ratio decidendi in the gas companies' cases as being the vehicle by which the generating power is conveyed from the power house. I think that they are so intimately connected with the source of motor power as to become as much realty as say a shaft drawn by a central machine, or a cable laid along or under the public streets. I think the rails, if utilized for conveying the current to the motors, or after the expenditure of its force on the motors, returning it to the power house, in other words, completing the circuit, would be assessable, but if such circuit could be completed without the aid of the rails that then the rails would not be assessable, because they would form part of the highway constructed and used for the purpose of more effectually and rapidly furnishing the paramount object highways are established and maintained for, namely, rapid, convenient and efficient transit and traffic.

To illustrate my view as to the non-assessability of the company's rails, I would suppose the not unlikely case of the city, instead of constructing, maintaining and keeping in repair the public streets of the city, had, under contract with some construction company possessing the right to use some new or advantageous form or method of street paving, employed them for a consideration to do this work at an annual rate for a term of years; would it be just, equitable or fair for them to seek to diminish the price they have engaged to pay by an assessment upon the value of the material used in the construction of the pavement? I submit that the difference between that case and the use of the rails of this company for the greater ease of traction is only one of degree.

The judgment of the Court of Appeal in the gas case, in which the gas mains and pipes were held assessable, proceeds largely upon the assumption that those mains and pipes are, as Mr. Justice Rose expressed it (23 A. R. at page 556) "liable to taxation as part of the property of the company, increasing the value of the building and plant." It could not well be held otherwise, for the special case submitted to the court expressly states that these mains and pipes "were attached to buildings and plant of the company." Unless the use of these rails for this company for the purpose of transmitting the motor power can be said to attach them to the plant and buildings of the company—to my mind they are entirely detached, and are personable property and are non-assessable. It is not essential that this company should use this current in this particular way as a motive power. They could use it in another way by erecting a return wire, discarding the current by means of the rails, or they could establish storage batteries or motors driven by compressed air, or by other means which the advance of science is so constantly suggesting.

I have perused the report of the New Brunswick case cited to us and am not convinced that it is an authority binding upon us. I have considered the effect and the meaning of the references to "tax" in the agreement of the contracting parties. To my mind it does not refer to more than such taxes as were no doubt imposable upon such property of the company as is not placed upon the streets of the city, the use of which was the franchise which was the subject matter dealt with. The company would require other property, such as their power-house. They would have to erect or rent office buildings, waiting rooms, car stables, etc., and might require space, buildings and machinery for the construction of cars, etc. The reference to these transactions was wisely inserted in the document for the purpose of avoiding any difficulty which might arise as to the disposition of these taxes between the public and the separate schools.

This brings me to the consideration of the concluding argument advanced by the company against the imposition upon them of these taxes, viz: That to do so is to import into the agreement between contracting parties a new and onerous condition or stipulation which was never in the contemplation of the parties to the contract at the time of its execution; which it would be inequitable to enforce, and which cannot be evolved from the four corners of the document as it stands.

Corporate bodies are bound by the same rule of law and conduct as individuals. Their component parts are variable, but the corporation continues to exist as a whole. The city may change its policy or reserve its former action, but it must always be held to its contracts and agreements entered into previous to such change or reversal. The agreement between these two contracting corporations was the outcome of a contest between men of keen business and legal acumen, and after the fullest and most prolonged discussion the result was embodied in the pages of this document. These parties had before them the judgment of the highest courts of the province declaring that this very property of this very railway is not liable to taxation. Because, since that decision, a change has been made in the verbiage of the Assessment Act, and the authority of such decision by a subsequent judgment is supposed to be weakened or impugned; because "Another king has arisen which knew not Joseph," is that a reason why the parties should either be relieved from an obligation or have another onerous one imposed upon them? I humbly conceive not. If the legislature to-morrow passed a law declaring that the rails, poles and wires of all street railways are liable to taxation, I do not see how the position of this company would be effected, unless it was declared that such legislation should be expost facto. This might be confiscation, but it would have to be obeyed. I think this corporation is endeavoring to filch with one hand what they have given with the other.

I have considered the point whether this tribunal has any power or authority to determine more than the question whether this particular kind of property or any part of it is liable to taxation or not. In my opinion, to do so would be "Academic" only and would not be a binding value, or such a determination or finding that the contestants are entitled to. This court is one of review upon the proceedings upon a body of men composed in all urban and rural municipalities except the city of Toronto of all, or the greater part of, the members of a corporation, one of the litigants. It is meant to be a check upon their proceedings and is given power to redress a wrong when a wrong has been done. If this corporation, after granting an exemption from taxes, had undertaken to assess and levy taxes, contrary to such an agreement, the Courts would quickly interfere and restrain them. I think this Court would have equal authority.

With great diffidence I venture to place on record my opinion that (save in so far as my judgment agrees with that of my brother McDougall) the judgment of the Court of Revision should be reversed with appropriate costs to be paid out of the fund paid into the City Treasurer to cover the costs of appeal.

MCDUGALL, J.:—The first question I propose to consider is as to whether street railways come within the purview of sec. 29 of the Assessment Act; because if they do so the superstructure is not assessable, under several decisions in our own courts. *G. W. R. vs. Rouse* 15, U. C. 168; *London vs. G. W. R.*, 17 U. C. 262, approved in *Central Vermont Railway vs. St. Johns*, 14 Supreme Court 288. It is well to note that in the case of the Toronto Street Railway Co. v. Fleming, 35 U. C. 264, and appeal 37 U. C. 116, no question was discussed as to the right of the plaintiffs to excape taxation on the ground that the superstructure of their road was exempt. Richards C. J., and Wilson J. placed the liability on the company because they occupied with their tracks the soil on the highway, and that that occupation and user, though not exclusive, was an interest in lands. The thing (track) they had fixed to the land became land, and (like gas mains laid beneath the surface), was liable to taxation. It was argued that the case of the Toronto Railway v. the Queen, decided recently by the Privy Council, determines the status of a street railway, and makes it a railway within the meaning of the Custom's Act, and in consequence, for the purposes of the Assessment Act, it must be viewed as a railway as much as the Grand Trunk or Canadian Pacific. I do not so read the decision. Toronto Railway v. the Queen simply decides that when steel rails above a certain weight, and to be used in railway tracks, are exempted from duty, the general expression "railway tracks" is sufficiently broad to include the track of a street railway which uses such rails in the construction of their roadway, and in this manner provide a permanent way for their cars. Lord Hobhouse, in delivering the judgment of the Court, says: "The appellants then are the owners of what the Legislature of their own Province calls a single or double track street railway, and the line which they work is called a railway track. These expressions are not conclusive as to the meaning of the term as used by the Dominion Legislature in the Act under discussion, but they show that the term is known to the Canadian draughtsmen of statutes in Canada, and is there applied to such a line as that of the appellants. It seems to their Lordships to be good evidence as to the meaning in the mouth of a Canadian Legislature, and to afford prima facie ground for holding that railway track includes the line of street railway." Again he says: "It may be in other Acts and for other purposes there are substantial distinctions between railways or railway tracks and tramways, but for this purpose and in this Act and its three predecessors (Customs Acts) there is not traceable any idea of making such a distinction, but rather the idea of putting all kinds of railways on the same footing. . . . Now, when we trace up the history of sec. 29 of the Assessment Act of 1892, we find a section substantially the same introduced on the first time by 16 Vic. cap. 182, sec. 21 (1851-3) requiring railway companies to transmit to the clerk of the municipality the statement therein provided. This section is preserved with very slight verbal alterations in all the subsequent Assessment Acts down to 1892. It could not be said that this section was intended to include street railways at the time of its introduction, for none, so far as I know, were then in existence, at least in Canada. They are a more modern creation. The railway companies intended to be covered by sec. 29 of the Assessment Act are in my opinion only those companies which are subject to the provisions of the Ontario and Dominion Railway Acts. The other companies are known as street railways, and were always incorporated by special Acts of Parliament. They may since 1893 be formed under the provisions of the Street Railway Act R. S. O. 171. It is quite true that the expression "railway track" is in some sense a generic term; but, as I have said before, an examination into the origin of sec. 29 in my opinion clearly shows that it was never intended to apply to or to include a street railway. The fact that this contention, though raised in the reasons against appeal, is not mentioned in the judgments in appeal in the Toronto Street Railway v. Fleming—the only case where the taxable status of a street railway company has been enquired into prior to the present appeal—in some degree strengthens the opinion above expressed. If I am right in this conclusion, then such decisions as *Great Western Railway Co. v. Rouse* do not apply to street railways.

The next important matter to be considered is the effect of the decision in the Court of Appeal of the Toronto Street Railway v. Fleming, 37 U. C. 116. A judgment in that case was pronounced in 1875 upon the clauses of the Assessment Act as they stood at that date. Sec. 3 of 32 Vic. cap. (36 Ontario, 1869) read:—"(3) The terms land, real property and real estate respectively include all buildings or other things erected upon or affixed to the land, and all machinery or other things so affixed to any building as to form in law part of the realty, and all trees or underwood growing upon the land, and all mines, minerals, quarries and fossils in and under the same, except mine belonging to Her Majesty." Sec. (4) "The terms personal estate and personal property include all goods, chattels, shares, incorporated companies, interest on mortgages, dividends from bank stock, money, notes, accounts and debts at their actual value, income and all other property except land and real estate and real property as above defined and except property herein expressly exempted." Sec. (5) "The term property includes both real and personal property as above defined." Sec. (9) "All land and personal property in the province of Ontario shall be liable to taxation, subject to the following exemptions, that is to say—'Now, in the Act of 1892 the 5th section of the Act of 1869 is transposed, and becomes sub-sec. 8 of sec. 2 with a slight change of wording. It now reads: Sec. 2 sub-sec. 8 "Property shall include both real and personal property as hereinafter defined." Sub-sec. 9 takes the place of sec. 3 and reads: "Land, real property and real estate shall include," etc.—following the exact words of the old section, with the addition of the words "and land covered by water." Sub-sec. 10 takes the place of sec. 4, with some additions and modifications of the importance of this appeal. Sec. 9 of the Act of 1869 has an important change

made in it, and becomes sec. (7) in the Act of 1892, and reads now as follows: (7) "All property in this province shall be liable to taxation subject to the following exemptions, that is to say: The first point to be noticed is the passage in the judgment of Patterson, J., in the Court of Appeal in Toronto Street Railway v. Fleming, at page 126. He says: "If there was a general law that all property should be assessable for municipal purposes, I should have no hesitation in deciding that this was assessable property. The question, however, is: Is it assessable as land?" Mr. Patterson then proceeds to argue that as, in the exemption clauses, sub-sec. 6 exempts every public road and way, or public square, and as it is sought to assess the company in respect of the portions of the streets used for the purposes of the railway, and it is only land that can be assessed, they are not liable, because all the land in the public roads is exempt. Upon reference back to the case stated in Toronto Street Railway v. Fleming, reported in 35 U. C. 264, it will be seen what was the subject of the controversy there and the assessment or alleged claim for taxable liability which was under consideration, in order to contrast it with the subject-matter of this appeal.

Paragraph 2 of the stated case shows this put clearly, and reads as follows: "The assessment for the said taxes in regard to which the said distress was made by the defendant was made by the city of Toronto in respect of the portions of Queen street, Yonge street and King street used by plaintiffs for the purposes of their said railway under the provisions of the Act, statutes and by-law hereinafter referred to." The present appeal is against the assessment of the company under the head of lands, buildings and improvements, and in the column headed "Value of Buildings and Improvements" the disputed assessment appears as follows:—

VALUE OF BUILDINGS AND IMPROVEMENTS.

{ \$ 4,000
\$537.137—rails, wires and poles used by the company in connection with the said lands for the purpose of operating its railway in and upon the lands of the company or the streets of the city.

What this appears to mean I take it, is: rails, wires and poles used by the company, placed on the lands of the company or on the streets of the city, which said rails, wires and poles so placed as aforesaid are used by the company in operating their railway. Now, it has recently been held by the Court of Appeal in the *Gas Consumers' case v. Toronto* that the gas mains laid in the public streets beneath the surface are assessable, notwithstanding the existence of sub-sec. 6 of the exemptions section. The Chancellor, in his judgment in the same case, 26 Ont., page 722, says (at page 729): "To tel graph companies the same rules apply where the wires are carried above or underneath the soil of the highway." In the *Electric Telegraph Co. v. Overseers of Salford*, 11 Exchequer, 181, the Court gave effect to the legal definition of land as including not only the face of the earth, but everything on it or over it; and that definition is not ruled out by our Assessment Act, which says, "land" shall include such and such meanings—not that all others legally possessed by the word shall be excluded. In *Pimlico Tramway Co. v. Greenwich*, L. R. 9, Q. B. p. 9, the company was held to be rateable as occupants of the highway by reasons of the tracks being laid thereon, because it was held that although they had not the exclusive use of the surface of the track, that being in the exclusive occupation of any portion of the soil, as they were in laying their tracks in the same, they were liable.

Lord Blackburn, at page 14 says: "There is a considerable resemblance between the iron tram rail or artificial tramway here and the pipe which is laid down, though there is this difference, undoubtedly, that the pipe (I do not know that it would be necessary if it should be so) is generally buried in the soil some way below the actual pavement or macadamized road which forms the thing actually supporting the carriages passing along; but I do not think that makes any difference."

Lush, J., said: "I am of the same opinion. The Act of Parliament enables the proprietors of a tramway to appropriate to their own purposes a given portion of the public road for the purpose of laying down the tram rails which are requisite for the conveyance of their carriages along the line of road. The tram rails occupy a portion of the soil. They are exclusively used by the tram rail company for the purposes of the tramway, and that, I think, makes them occupiers of that portion of the soil. I do not think they are the less occupiers because the public as well have the right of way over the surface of their iron road; and the road, as a tramroad, is in their exclusive use, and used for their exclusive benefit."

Quinn, J., said he was unable to distinguish the case from the cases which had been decided on the occupation of land by water companies and gas companies. At page 16 he says: "It appears to me that no difference can be pointed out between this tramway and those gas and water mains, except that the gas and water mains are deeper in the soil than this iron tramway." Again he says: "I am unable to distinguish the iron tramway from the gas and water pipe. Both physically occupy the soil. One is somewhat deeper than the other, the tram rail having the upper surface level with the road, but they both occupy the soil of the road physically, and in exactly the same manner. I do not see either in sec. 57 or sec. 62 any provision which in any way interferes with that principle. They only preserve the right of the public to go over the surface as before, but in no way is it stated that these tramways so made, and the baulks of timber upon which they are laid, were part of the road in the sense of being the property of the public authorities. They remained the private property of the tramway company, and they by means of the iron rails and the baulks of timber are occupying the soil of the road in the same manner exactly as the gas pipes and water pipes; and the latter being rateable, I think the former are also rateable."

I have quoted at some length from this instructive judgment because I think its language is singularly y opposite to the questions in issue in this appeal. The position of the tracks, ties, etc., of the railway company buried in the soil, I cannot differentiate from that position of gas mains buried under the soil. The street railway has exclusive use of their rails and of the soil occupied by their rails and ties for the purposes of their business. It is true that the public can drive over and along these tracks. By their agreement with the city they are compelled to have them flush with the pavement to enable vehicles to do so; and they are consequently let into the soil except the mere surface of the rail. If gas mains are assessable, I am firmly of the opinion that these rails and ties are, with so much of the soil as is used therewith, really of the company, and in this respect assessable. As to this underground soil surrounding and between their ties and rails, they are owners and occupiers within the meaning of the Assessment law of Ontario. This conclusion is supported by the last cited English case of *Pimlico v. Greenwich*, and by the *Consumers' Gas Company v. Toronto*, 26 Ont. 722, and by the judgment of the Court of Appeal in the same case. Whatever doubt may have been felt as to the meaning of the word "land" as used in sec. 9 in the Assessment Act of 1869 is now, to my mind, dispelled by the change to the word "property" in sec. 7 of the Assessment Act of 1892.

As to the rights of the public, they are subordinate to the rights of the company, who have the right of way in preference to the public; the public must give way to them, to their cars, and they have in that way a prior and exclusive right to the possession and use of their tracks and rails. *Hellwell Union v. Helkyn Drainage Co.*, appeal cases 1895, page 117. In this last case—the case on *Pimlico v. Greenwich* is approved. The wires and poles in use by the Toronto Street Railway Co., to my mind, are also undoubtedly assessable on the principle defined by the case of the *Gas Consumers v. Toronto*, as being in precisely the same position as the gas mains, save that they are in the air over the highway instead of being buried in the soil, and the wires, posts and cross wires form one general fixture connected with and forming an unbroken connection with the power house of the company. Through them the electric current is carried along the whole system of the street railway to move their cars. Like the gas mains, they, thus united with the machinery in the power house, form one fixture with it, and it is one indivisible plant. They have the exclusive use of these poles and wires, beyond all doubt, and the public—whatever their rights may be on the surface of the street—have no joint or even subordinate rights in those poles or wires overhead. I refer to *Lancashire Telephone Co. v. Manchester*, 13 Q. B. D. 700 and 14 Q. B. D. 267 in appeal; *The Electric Telegraph Co. v. Salford*, 11 Exchequer 181; and the case of the *Consumers' Gas Co. v. Toronto*, 26 Ont. 722 and in appeal.

Mr. Osler, with reference to the nature of the title of the Street Railway Co. in the streets and in their tracks, contended that they only had a tenant's interest in them; that they had what practically amounted to a lease; and as lessees their interest was a chattel interest only. On reference to the conveyance by the city to the company of the street railway franchise acquired by the city from the old Toronto Street Railway Company, we find in clause this recital:—And whereas the said corporation resolved to sell to said railway all the property acquired by the city from the Toronto Street Railway Co. and also to dispose of the right to operate surface railways in the city of Toronto as hereinafter mentioned, etc., etc. (6) And whereas the corporation advertised for tenders for the purchase of the said railway property and privilege, and the purchasers (Kelly, McKenzie and Everett) tendered therefor, and their tender was duly accepted. Then in the 10th clause it is recited that in consideration of \$475,000 paid by the purchasers to the corporation they (the corporation) do sell, grant and assign to the purchasers, their heirs, executors, administrators and assigns, all the said railway and property acquired from the Toronto Street Railway Company. Clause 11, for the same consideration as mentioned in clause 10, goes on to grant to the purchasers, their heirs, executors, etc., etc., for twenty years with the right to renew for ten years, the exclusive right for the said periods to operate

surface railways in the city of Toronto. Now, two things are dealt with: The property, tracks, equipment, stock, plant and real estate acquired by the city from the old Toronto Street Railway Co. This was sold absolutely to the new company. Next, the franchise to operate, for a limited time, surface railways, is conferred. The property, or the portion thereof here sought to be taxed, was sold outright; but the franchise or privilege to operate a surface road was conferred for a term only. What is sought to be reached by the present assessment, to be taxed, is the property, not the franchise. That there was a sale is made more manifest by turning to sec. 4 of the Act of Incorporation of the Toronto Railway Company, sub-sec. 2 and 3, where it is declared that if the city did not renew the franchise at the end of thirty years, and desired to take over the property, they are to pay the company therefor at a valuation to be determined by arbitration; and it is expressly declared that they are not to pay for the franchise.

Mr. Osler also urged that as the title of the highways upon which these rails are laid was vested in the Crown or in the municipality under section 525 and 527 of the Municipal Act, no portion of the soil is therefore taxable lands so vested being exempt. Sub-sec. 1 of sec. 7 of the Assessment Act reads: "All property vested in or held by Her Majesty, etc., is exempt"; but sub-sec. 2 of the same section declares: "When any property mentioned in the preceding clause is occupied by any person otherwise than in an official capacity, the occupant shall be assessed in respect thereof, but the property itself shall not be liable." Similarly, municipal property by sub-sec. 7 is declared to be exempt whether occupied for municipal purposes or unoccupied, "but not when occupied by any person as tenant or lessee, or otherwise than as a servant or officer of the corporation for the purpose thereof." The land is liable to be assessed, and the occupant made liable for the taxes.

I think, in view of these provisions, and of the conditions of purchase by the Toronto Railway Company, they cannot be deemed to be tenants of the city, but are owners of the tracks and plants, and are occupants of the streets, whether said streets are vested in the Crown or in the municipality; and as such occupants, they are liable to taxation, though the land itself, and as such occupied, is not liable for the payment of said taxes. The fact that under sub-sec. 2 of sec. 7 exemption clause, a special liability is created against an occupant of Crown or municipal lands to pay taxes in respect of such lands and of such occupation, develops a taxable responsibility almost identical with that existing in England, and hence decisions in the English courts upon this point are germane and cogent in determining questions arising in reference to this class of ratepayers.

I have already pointed out that so far as my opinion is concerned, I am unable to

distinguish any difference in liability between the owners of street car tracks buried in the soil twelve or eighteen inches, and the owners of gas mains buried four or five feet beneath the surface in the same street. The Court of Appeal for this province, by its latest decision upon the same sections of the Assessment Act, as now amended, has held that gas mains are assessable. In the present case I think I am justified in following the principle of the latest decision upon these troublesome sections of the Assessment Act. I feel less hesitation in doing this as the case of the Consumers' Gas Co. v. Toronto is now pending before the Supreme Court; and we are given to understand by counsel at the argument of this case that any judgment pronounced by this court would in all probability be taken for review to the same court of last resort. I hope this will be done, and the many conflicting opinions expressed by our ablest and most distinguished judges be finally reviewed by the highest court of the Dominion, and these vexed questions authoritatively disposed of.

I have only had the opportunity of seeing the judgments of my learned brothers a few minutes before coming into court. I cannot adopt the reasoning of my learned brother Dartnell that the corporation of the city of Toronto are not justified in making the assessment complained of in this appeal because such taxation adds a term or burden to the agreement entered into in 1871 between the city and the Toronto Street Railway Co. The agreement itself does not purport to deal with the matter of taxation. The question of liability to taxation of any species of property must depend upon the Statutes in force from time to time in this behalf. If the property in question in this appeal is assessable under the Assessment Act, no bargain or agreement, express or implied, made between the city of Toronto and the Street Railway Co. to exempt it from taxation, can have any effect unless sanctioned by the Legislature. No such sanction is claimed or shown, I venture to think, that the sole duty of this Court is to interpret the meaning of the taxing clauses of the Assessment Act, and to determine if the property assumed in this case is taxable property under the terms of section 7 of the Assessment Act, qualified by the exemption clauses of the same section. I can find no authority in the Assessment Act to enable us to administer so called equity, and to declare that although we may be of opinion that the property here sought to be taxed is legally liable, yet that it is unjust or inequitable to affirm such assessment because at some antecedent period when one or even both of the parties to a bargain or agreement incorrectly concluded that the class of property now sought to be assessed was not under the existing law liable to assessment and taxation.

The appeal was allowed with costs, McDougall, J., dissenting.

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Mr. Stanley Douglass is putting in an electric light plant at Stanley, N. B., to light the village and business places.

The Robb Engineering Co. have erected two tandem compound electric light engines for H. Walker & Sons, Walkerville, Ont.

The property owners of Southampton, Ont., will vote on a by-law to raise \$11,000 for the purchase of an electric light plant.

The construction of the Perth and Lanark Railway will shortly be commenced. Mr. Fowler, of Arnprior, is one of the promoters.

The Toronto Street Railway gross earnings for November were \$74,617, as against \$77,602 for the same month last year, showing an actual decrease of \$3,365.

The electric light company at St. John, N. B., have added two large generators to their plant, supplied by the Edison Electric Illuminating Co., of Patterson, N. J.

Another suit has been entered on account of the Point Ellice bridge disaster at Victoria, B. C. The city has issued a writ against the Victoria Electric Railway and Light Company, the

Consolidated Railway Company and N. Farrell, claiming \$25,000 damages for the collapse of the structure.

Mr. P. N. Smith, late manager of the Consolidated Railroad and Light Company, of Vancouver, B. C., is said to have been arrested for misappropriating funds of the company.

J. F. McLaughlin, late of Toronto, has bought the charter of the Spokane & Columbia Telephone Company. He intends to put in a system at Rossland first, then to extend to Trail and from there to Spokane via Northport.

A special general meeting of the shareholders of the Metropolitan Street Railway Company is announced to take place in Toronto on the 7th of January to consider the question of increasing the capital stock to \$500,000.

The State Department at Washington has received a description of a farm in Mecklesburg where electricity has been made to take the place of laborers in great part. A turbine drives a dynamo which lights the barns, yards and dwellings, and furnishes a current of low tension to work pumps, run a straw-cutter, lathe, grindstone, large handsaw and threshing machine. One machinist attends to the entire plant, which is said to have reduced the expenses of the farm in considerable degree.

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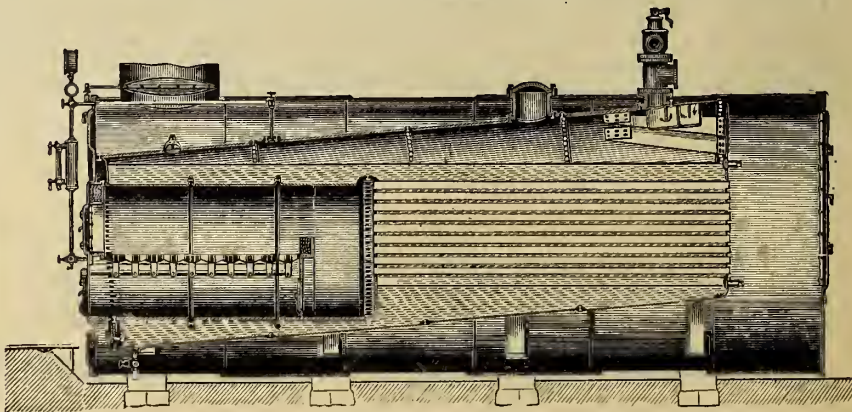
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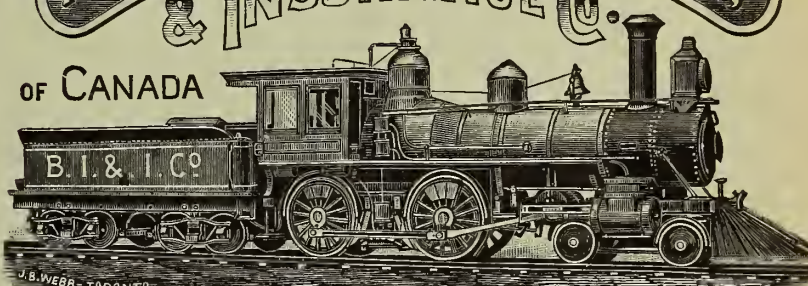
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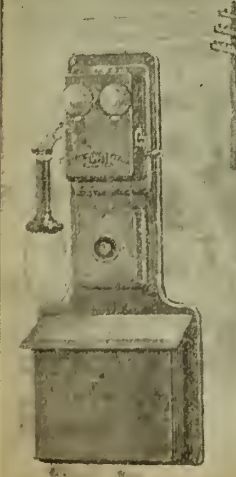
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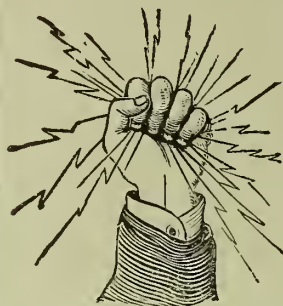
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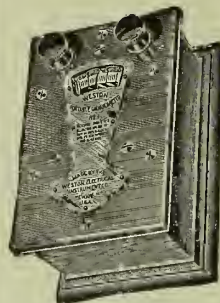
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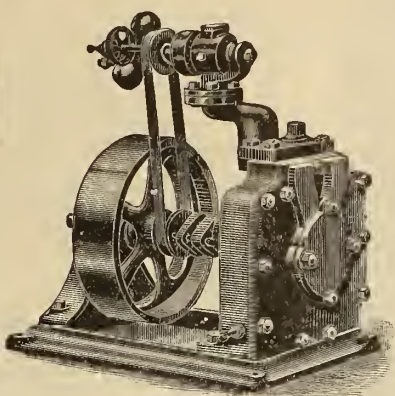
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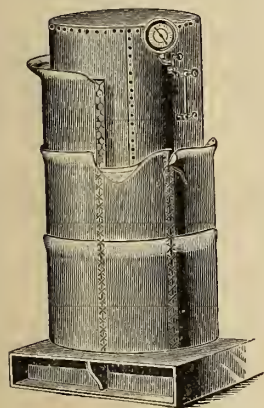
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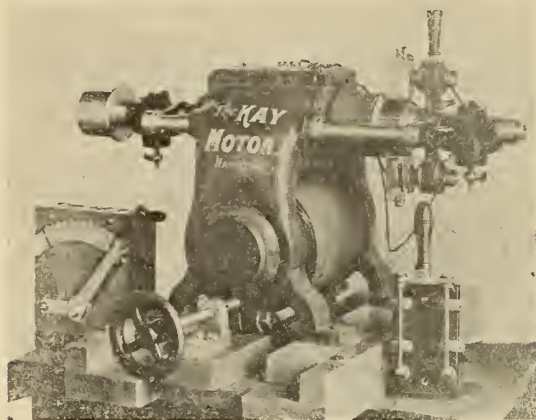
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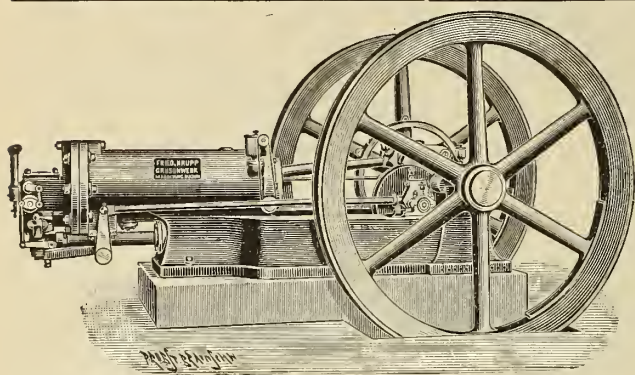
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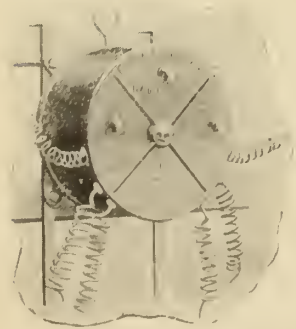
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CANADIAN
ELECTRICAL NEWS
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STEAM ENGINEERING JOURNAL.

VOL. VII.

FEBRUARY, 1897

No. 2.

**THE FIRE AT THE TORONTO ELECTRIC
LIGHT COMPANY'S WORKS.**

ON Thursday morning, Jan. 21st, a most disastrous
fire occurred at the works of the Toronto Electric Light

site some ten years ago. At that time it was considered
quite a building, and amply large enough for the work
for many years to come, but the rapid extension of the
business of incandescent lighting and motor power



VIEWS OF THE TORONTO ELECTRIC LIGHT COMPANY'S PREMISES, PREVIOUS TO THE RECENT FIRE.

Company, which resulted in the total destruction of the
arc lighting plant. The building, which was a frame
iron-clad structure, was the first building erected on the

necessitated other and larger buildings, notably the one
completed but a few weeks before the fire—an entirely
fire-proof structure, containing two one-thousand horse

power engines and 500 k. w. generators. The burned building was used exclusively for arc lighting, with sufficient power generators and alternating current machines to take the night load after midnight, when the plant in the western building was shut down.

The building contained sixty-two dynamos, of all sizes from 25 to 125 lights capacity each, and 4 pairs of horizontal Brown-Corliss engines of 500 horse power each, and 6 lines of shafting 62 feet long. The building was fairly well supplied with fire-extinguishing apparatus, including 4 sets of hose and nozzles, 15 extinguishers and innumerable pails kept well filled with water. It was thought that the continuous presence of workmen, during the entire day and night, together with these appliances, were a sufficient safeguard against any danger of loss by fire. Events proved differently, however.

The final cause of the catastrophe is somewhat difficult to arrive at. It appears that at about 4 o'clock in the morning, when all machinery was of course in operation, fire was discovered under one of the dynamos on the ground floor near one of the lines of shafting. According to orders in such an event, the engines were stopped, and the hands, together with the watchman whose duty it was to look after these matters, put out the blaze by using the extinguishers. After it was all out, and the wet belts taken from the dynamos in the vicinity, the engines were again started. This would probably be some fifteen or twenty minutes after the fire was out. The cause of what followed is now only a matter of conjecture. It appears that the various lighting circuits had only been fairly started when a sheet of flame shot up from the upper floor and appeared to envelop the entire building in that part. So rapid was its spread that, although the men sprang to the engines some of them were never shut down, and the man who remained to do it had to make his exit by a window. Just as many theories as to the cause of this second fire are advanced as there are individuals to express an opinion. The most probable one is that the acid from the extinguishers used may have sprayed upon some of the many wires, penetrated the insulation and even carried the high voltage current over the wet porcelain insulators. Be the cause, however, what it may, the fact remains that at 5 o'clock on the morning of the 21st of January, the Toronto Electric Light Company found themselves without an arc plant.

There are used for city lighting alone about eleven hundred lights, and for commercial use from five to six hundred more. No time was lost; while the fire was yet burning men were at work erecting new poles to carry the wires into other buildings, and the manager of the company put himself into communication by telephone and telegraph with every place at which it was likely that dynamos could be obtained. The response by the companies appealed to was both prompt and effective. The General Electric Co. had some dynamos of various kinds in stock, and they worked with a will. A car was loaded and shipped special from Peterboro'. At 4 o'clock p.m.—within seven or eight hours of the fire—it was backed into the siding of the Electric Light Company's works in Toronto. Two more cars were shipped and arrived a few hours afterwards. On receipt of a telegram from Toronto the Royal Electric Co. of Montreal put gangs of men to work to take out dynamos from their lighting stations, and even the machine used by them for testing lamps in their factory

was included. These were loaded upon cars and attached to the night express, reaching Toronto next morning. Within six hours of the fire a number of the latest type of Brush machines, of 125 lights capacity, were purchased and shipped from Cleveland and Lynn.

The result of this work was that the city was at no time without light. The company had a few small dynamos in their power station. These, with what reinforcements could be got in operation the first night, provided about 300 lights. This was sufficient for the centre of the city, and by using alternate lights in the outside districts the ground was fairly covered. The second night, with the exception of the extreme north-west section, a stranger would not have noticed anything unusual, and the succeeding five nights the number was added to until, within one week of the fire, the entire number was again in operation. Two dynamos were placed in the power house of the Toronto Railway Co. and a number in the incandescent light station of the Toronto Electric Light Co. at Terauley street—the remainder on the engines at Scott street and the Esplanade, that were used for driving power generators.

When the weight of the machinery required for this work is taken into consideration, as well as the intricate and delicate adjustments required, and the disorganization of the circuits caused by the loss of the distributing switchboard, it will be seen that the work done was an achievement of no ordinary magnitude. Within 36 hours of the fire the employees of the company handled and placed in position close upon one hundred tons of machinery.

In speaking of the fire Manager Wright was most enthusiastic in his expressions of appreciation of the manner in which the companies concerned came to his assistance, and of the untiring and devoted energy of his employees.

The Toronto Electric Light Company intend to replace the burned building with an entirely up-to-date fire-proof structure, so that a recurrence of the disaster will be rendered an impossibility. The engraving we present shows the works of the company as they were before the fire. The engine in the upper left hand corner is one of those just installed in the new power house for driving power generators. The building shown to the left foreground of the picture is the one destroyed. A steam derrick has been erected in the ruins to handle the heavy machinery and get the ground cleared for the new works at the earliest possible moment.

THE CHAMBLY POWER WORKS.

THE works for the utilization of the water power at Chamby, Que., are making satisfactory progress. A concrete dam is nearing completion, which will make possible the development of 20,000 h. p., delivered to shafts in eight units, besides two units for exciters. The generators will be direct coupled to water wheels, and each unit of generator will be 2650 h.p. capacity. These generators are now in process of construction at the Royal Electric Company's works at Montreal. They are to be two-phase "S.K.C." inductor type alternating current, generating current direct from the machines at an impressed E. M. F. of 12,000 volts. There are a number of novel features connected with the working out of the enterprise—one being the high electromotive force of the generators and another the capacity of the machines.

CHEMISTRY IN THE BOILER ROOM.

PART II.

By WM. THOMPSON, Montreal West.

BEFORE we proceed to the study of what takes place during combustion, it is necessary that we should briefly consider certain substances called "elements." An element is a substance that cannot by any means known to chemistry be reduced to a simpler substance. Iron, for instance, is an element—so is silver, carbon, oxygen, hydrogen, and many other substances which it is not necessary for me here to mention. In addition to the substances called elements, we have other substances called "compounds." A compound is a substance made up of two or more elements, held in mechanical or chemical combination, and can by certain processes be reduced to its simpler elements. For instance, water is a compound of the elements hydrogen and oxygen; coal is a compound of carbon, nitrogen, hydrogen and certain other elements; air is a compound of the elements nitrogen and oxygen.

Substances are said to be held in mechanical combination when the elements composing the compound are able to be separated or distinguished by mechanical means, and differs from a state of chemical combination inasmuch as the elements composing the compound are simply side by side. For instance, the elements iron and sulphur can be ground together in the finest possible atoms imaginable, still they form only a mechanical compound, as both the iron and sulphur retain their original properties and can be separated one from the other by simple mechanical means, and they have not really combined one with the other. But if you heat the substance they enter into chemical combination one with the other—the iron loses its properties as iron; the sulphur loses its properties as sulphur, and they can only be decomposed again by chemical means. The iron is no longer visible as iron, and the sulphur is no longer visible as sulphur—the two elements have combined together to form a new substance, a compound of iron and sulphur, known in chemistry as iron sulphide. Just so long as they were held in mechanical combination they remained iron and sulphur, each retaining its own peculiar properties, but when they were brought into chemical combination by means of heat the properties belonging to both the iron and sulphur disappeared, and a new substance was formed, with entirely new and different properties.

As the reader is no doubt aware, there are a great many different grades of coal, and generally divided into two distinct classes, known as anthracite (hard) and bituminous (soft), both of which are largely used for the production of power.

For our purpose we will take a sample of Welsh coal, the analysis being as follows: Carbon, 85%; hydrogen, 5%; nitrogen, 1%; sulphur, 1%; oxygen, 3%; and incombustible matter, called ash, 5%. This sample of coal then is a chemical compound containing these various elements in different proportions, and before it can be changed into any other substance, decomposition must take place.

Atmospheric air is composed of nitrogen and oxygen in mechanical combination in the proportion of 4 parts of nitrogen to 1 part of oxygen by volume, and by weight, 77 of nitrogen to 23 of oxygen.

To enter into the philosophy of chemistry in this article is not my intention, but to make the matter clear it will be necessary to discuss the properties of each element and also the properties of the different compounds when in combination with each other. We have the following elements to deal with, only two of which are solids, as follows: carbon, solid; hydrogen, gas; nitrogen, gas; oxygen, gas; sulphur, solid. The reader already knows that the bringing into combination of the atmospheric air with heated coal, causes the coal to burn and give out heat. This is, however, far from being the mechanical operation so often imagined. What really does take place is that the oxygen of the air enters into chemical combination with heated coal, and this very act of combination gives out the light and heat so often noticed. When chemical combination between substances has taken place, new substances are formed, just as when iron and sulphur are chemically combined iron sulphide is formed. Let us now review briefly the properties of each element when dealt with separately. To do this properly requires a certain amount of laboratory training, so that each element may be separately dealt with, and its various properties discovered. A description of experiments to be carried out is much too long for this article, so we will simply state well-known facts relating to each element in question.

CARBON is an element that occurs extensively in nature in many forms. The form in which we get it in the present instance is the well known substance "coke." Carbon has strong affinity for

oxygen, and combines with it in two proportions under certain conditions.

HYDROGEN is a colorless, inodorous, tasteless gas, of a very light nature, being $14\frac{1}{2}$ times lighter than air. It is combustible, but does not support combustion. It will combine with oxygen to form water, in the proportion of 2 parts hydrogen to 1 of oxygen by volume, or 1 part hydrogen to 8 parts of oxygen by weight.

NITROGEN, as already stated, forms four-fifths the volume of the air. It neither burns nor supports combustion, and acts as a diluting agent with oxygen. It has been said it is simply in mechanical combination in the air with oxygen; that is, the atoms of each are simply side by side, each retaining its own peculiar properties.

OXYGEN is in present instance our most important element, and a proper understanding of its power to combine with carbon forms the most important part of an engineer's education. Pure oxygen is a strong supporter of combustion, and combines readily with many elements, in each case giving off light and heat. With carbon it forms two highly important compounds, known as carbon dioxide and carbon monoxide—carbon dioxide being the result of perfect combustion and carbon monoxide the result of imperfect combustion. While oxygen supports combustion, it is not combustible itself, all its properties being practically the reverse of hydrogen.

Nature has provided that the elements will only combine together under certain conditions and in certain well-defined quantities, and it is the understanding of these conditions and quantities that makes the study of chemistry of any value to us. If carbon and oxygen simply united in any proportion, and when in combination each was destroyed, then we should require no knowledge of chemistry; but every fireman knows he must get so much air from the atmosphere, must kindle a fire before it will burn, and must maintain a current of air through his fires, and that the intensity of his air current enables him to burn a given quantity of coal in a given time. This simply goes to prove that there are conditions as to what oxygen shall be supplied, and governing the temperature at which the two elements will combine. For instance, just so long as iron and sulphur remained together at a low temperature no change took place, but as soon as a given quantity of heat had been imparted to the substance combination took place; and if we test carefully we shall find there is a certain fixed quantity of heat required, and that a certain temperature must be reached before chemical combination sets in, and that in every case these two elements require the same number of heat units and same temperature to be reached—enabling us to determine exactly what is required to change iron and sulphur into iron sulphide.

The same thing can be said regarding coal. Just so long as the compound remains at a given low temperature, decomposition and combination with oxygen will not take place. You can pass all the air you like over coal in its normal condition and you will get neither light nor heat, but heat the coal to a sufficiently high temperature and combination at once sets in, and decomposition of the compound of coal takes place. This is well illustrated in the manufacture of gas. A coal compound, chosen for its richness in gaseous elements, is placed in a closed retort, secure from admission of air, and a fire built underneath to heat the coal, which is decomposed, all the gases being liberated, the carbon and solids only remaining—proving that a compound of coal can be decomposed into its elements by heat, and that the element carbon is of such a nature that it will not pass into a gaseous state by the application of heat alone, as did the other elements contained in the coal. I want to impress my readers with the importance of this natural law, as it is of vital importance to engineers. I have said hydrogen combines with oxygen to form water, but only on certain defined conditions and in given quantities. Hydrogen and oxygen can be mixed together in exact quantities, and they will still remain in mechanical combination, but the moment they are heated up to a given point chemical combination sets in with such rapidity that an explosion occurs, and instead of the two gases we formerly had we have a liquid called pure water—very much smaller in volume but equal in weight to the weight of the gases before combination took place. Then we have a fixed point of combination and also a fixed quantity. If in the mechanical compound of the two gases we had an excess of hydrogen or oxygen the excess of either gas will remain behind in an uncombined state, showing that hydrogen will only combine with oxygen to form water in one fixed proportion, and hence excess of either of the elements can be considered as so much waste.

What I want to make clear is the important fact that carbon and oxygen will combine together in two different proportions and form two gases with entirely different properties, in each case giving out both light and heat, but in proportions that simply astonish the engineer, and the power to understand this fact is our most important duty.

(To be Continued.)

KINKS WITH THE STEAM ENGINE INDICATOR.

THE indicator, while it is primarily intended for indicating the performance of an engine, can be utilized for a number of other purposes and will frequently serve to assist an engineer out of a predicament. This article will be devoted to some of the special employments to which the instrument may be put.

There is a convenient method for measuring the speed of an engine by the use of the indicator which may be exceedingly useful in case the speed counter is not at hand, as is often the case, and the speed of the engine is high.

The indicator being connected to the engine at either end of the cylinder, the procedure is as follows: Disconnect the cord from the reducing rig and take it in the hand as shown in Fig. 1. At a given instant press

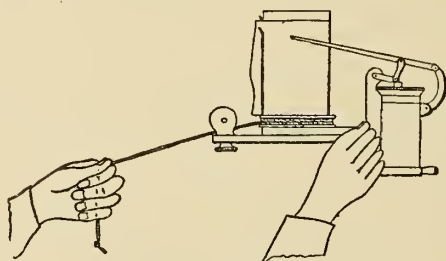


FIG. 1.—MEASURING SPEED OF ENGINE.

the pencil motion against the drum, at the same time drawing out the cord with the hand, releasing the pencil motion after a certain definite time has elapsed. A record such as is shown in Fig. 2 will be produced. It is obvious that the number of crests to the jagged record indicate the number of revolutions that have taken place in the interval, and from this the speed of the engine can be calculated.

The engineer who has handled an indicator but little sometimes finds it difficult to appreciate the fact that it may be used with advantage in scores of other places about the plant than the engine. Oftentimes many a "freak" card may be explained by taking a diagram with the indicator tapped into the pipe connecting the two cylinders. Where a receiver is used, this application of the indicator would show little or nothing, as the pressure in such a receptacle is quite constant. In the steam pipe before it enters the engine the indicator has been used to demonstrate the necessity for a steam reservoir or cushion. A Bourdon gauge attached to a

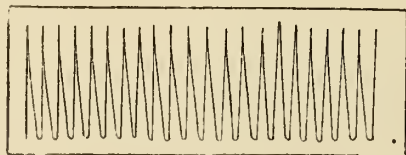


FIG. 2.—ENGINE SPEED CARD.

shaking steam pipe will be as much effected by mechanical jar as by variable pressure, but by means of the indicator the momentary drop of pressure on admission, or the sudden use at cut-off due to the inertia of the steam, can be shown and measured, and judgment can be passed as to whether or not a reservoir will lessen these evils. Indicators can be used on steam pumps, applied to either the steam or water cylinder, on gas engines or any appliance where there is a variable pressure to be measured. Care must be always taken to anticipate the pressure nearly enough to use a spring of proper scale. The pressure can be recorded with

reference to any mechanical event by using a suitable reducing motion connected to the mechanism with reference to which the record is to be taken.

Governor cards indicate almost as much about the regulation of an engine as do the ordinary cards about the events of the stroke. Fig. 3 shows such a card. The method of obtaining it is as follows: Load the engine with some power consuming device that can be thrown off either instantly or gradually, as may be preferred. A dynamo is very suitable for this purpose. Have the indicators ready, the drums oscillating and the pencil movement in motion. Let there be two men, one to operate the indicators and the other to manipulate the engine load. At a given instant let the load be suddenly varied and at the same time press the pencil motions of the indicators against their drums, having previously taken the record with the original load. Hold the pencil motion on until the engine seems to have attained a steady speed and the record similar to that of Fig. 3 will result.

The card thus taken is significant of many things. On it there are two cards which are made quite plain by frequent retracing. One lies within the other. These are the initial and final load cards. The number of complete cards between these two, or rather, other than these two, is the number of complete revolutions that the engine made before it succeeded in readjusting itself to the new load. On a good engine this number is very small.

The card serve to show also how the engine accomplished its speed control, whether by legitimate control of the cut-off or by varying some of the other events also, the latter always being more or less objectionable.

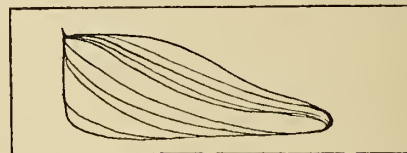


FIG. 3.—ENGINE REGULATING CARD.

A governor card loses its value as such if the load is gradually varied, for the intermediate cards will then indicate a gradual and proper control of the steam distribution to fit the gradually increasing or diminishing load, as the case may be.

If, however, there are but two loads, a maximum initial load and a minimum final one, any card between the two indicative of these loads is one of transition and taken while the engine was regulating.

The necessity of being able to take cards at a given instant has been shown in the foregoing, and this need would be more apparent in a test on a multiple expansion engine with two indicators on each cylinder. Without such simultaneous record, the result would lose much of its value and the cards would certainly not be comparative. This simultaneous action can be conveniently accomplished by the use of the electro-magnet. An electro-magnet can be so placed on each indicator that when the former receives current it will press the pencil motion against the drum, and on the breaking of the circuit the pencil motion can readily be caused to fly back by means of a spring. Connecting the magnets of all the indicators in series, they will form a circuit of high resistance and should be worked by a number of cells in series or by a 110 volt electric light current.

Ordinary magnets, such as are used on electric bells, will answer excellently, and five or six of them in series

will offer enough resistance so that an electric light current can be used with safety. If there are only one or two magnets they should be protected from excessive currents by placing them in series with one or more incandescent lamps connected in multiple, or else a battery should be used. A switch or push button gives appropriate control. The application of these magnets will be different with different makes of indicators, and it would take too much space to describe them all. A little ingenuity will always solve the problem. It may be necessary to fasten a metal strap to some part of the pencil motion support in order to enable the magnet to actuate it. Such electro-magnetic mechanisms are sold with some indicators as a regular part of their equipment.—American Electrician.

BY THE WAY.

MR. T. L. Willson, of acetylene gas fame, has been taking an active part in the discussions at Hamilton relative to the utilization in Canada of the power of Niagara. Among many other things he is credited with having said that it cost him upwards of \$300,000 to make available 1000 horse power on the Welland Canal, and for this amount 60 h.p. could be made available at Niagara. Some acetylene or other kind of gas appears to have found its way under Mr. Willson's hat.

× × × ×

THE individual who in Canada is caught in the act of tapping an electric wire or a gas main is promptly called upon to show cause why he should not be sent to jail. It is different in Germany. The Superior Court of that country recently decided that electricity, not being a movable object, could not be stolen. In pursuance of this peculiar method of reasoning, a man who had tapped the mains of an electrical company to get current with which to operate his motors, was acquitted of a charge of wrong-doing.

× × × ×

THE number and capacity of electrical manufacturing establishments in Canada, have so increased as to sometimes cause me to wonder how it is found possible to sell so large a quantity of electrical goods in a country with a comparatively small population. The fact, however, that these manufactories are constantly busy and that several of them have found it necessary to enlarge their facilities, is proof of the existence of a steady growth of demand. There is also the additional evidence before us that last year electrical goods to the value of nearly a quarter of a million dollars were exported to Canada from the United States.

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PROF. Henry A. Rowland, of the Johns Hopkins University, is said to have brought to commercial perfection a multiplex printing telegraph, by means of which an operator can transmit a telegram written upon a typewriter and have it reproduced in typewritten form at the receiving end. In addition to the typewriting part of the invention, Dr. Rowland, with his new machine, can send over the same wire five or six different messages at the same time in one direction, which, in duplex, makes ten or twelve messages that can be transmitted on the same wire at the same time. Thus, with five operators at each end of a line, sending each an average of thirty words a minute, three hundred words can be transmitted each minute. The current of

electricity transmitting the message can be relayed, and in this manner the invention can be operated for great distances.

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THE remarkable statement was made to me the other day, by a gentleman who has had a thorough training and wide experience in mechanical matters, that for twenty years the city of Toronto spent twice the amount of money which was necessary for coal for the city waterworks pumping station. It may be remembered that only within the last three or four years, and since the introduction of the Hawley down draught furnace, has soft coal been used at this station. Prior to that time hard coal was employed, costing all the way from \$3.75 to \$5.00 per ton. The gentleman to whom I have referred makes the claim that the credit which has been given by the City Engineer to the down draught apparatus, for the large saving effected in cost of fuel, is one to which it is not entitled, inasmuch as soft coal might have been used during the years above mentioned, apart from the use of any such special device. My informant states that he has always used soft coal on ordinary furnace grates and without any artificial draught, the sole requirement being that the fireman must attend strictly to business and feed the fuel frequently and keep the grates clear of ash. "Once, during a strike at the coal mines," said he, "we were obliged for a time to burn hard coal, and it almost ruined us; yet the city, as previously stated, used nothing else for nearly a quarter of a century."

MONTMORENCY ELECTRIC POWER CO.

THE Montmorency Electric Power Co., Quebec, have decided to make extensive improvements in their generating station at Montmorency, and also in their sub-station in Quebec, and with this object have contracted for machines of more modern type and of larger capacity than those they are now operating. The entire arc lighting plant, including water power equipment, will be discarded, the intention being to put in water wheels of larger capacity and better adapted to the conditions. In making the alterations to the arc lighting plant it is the intention to install new arc machines, recently purchased, of the Brush type, in the sub-station in Quebec, each machine being of 125 lights capacity. Two of these machines will be coupled to one synchronous motor of 200 kilowatt capacity, of the Stanley type, manufactured by the Royal Electric Co., of Montreal. Two of these motors will be installed, each motor driving two machines. The above changes are expected to be completed about the middle of May, when the company will be able to lay claim to having one of the most modern plants in existence. In the advertisement pages of this number the company offer for sale the material which they have been compelled by the proposed changes to discard.

The amount of capital invested in electric mining machinery in the United States, says the New York Times, is estimated to be over \$100,000,000, while that invested in stationary electric motors, used for the operation of machinery of all kinds and in all manner of shops, is over \$60,000,000. The number of electric motors in use is not definitely known, but is believed by those best able to judge to be over 500,000.

ANSWERS TO ELECTRICAL PROBLEMS.

1. What is the three-wire system?

ANS.—A system of running incandescent lamps with a smaller outlay for copper than the regular multiple-arc system, which is credited to the inventive ability of Thomas A. Edison. It consists of two multiple-arc circuits side by side, and the middle wires combined in one; that is, the positive of one circuit and the negative of the other are represented by one wire. This requires two dynamos in series, and when all the lamps are burning we virtually have a multiple series circuit with two lamps in series across a 200-volt circuit, for the dynamos being in series we have 200 volts between the outside wires and two 100-volt lamps in series, thus obtaining the advantages of a higher voltage with only 100 volts between the lamp terminals, and allowing a smaller wire to be used. If, however, we turn out lamp number one, the current through lamp number two goes down the middle wire and back to the dynamo through number one. The middle wire is called the neutral or balancing wire, and takes the unbalanced current when there are more lamps burning on one side than the other, and as the burning lamps are practically never all on one side, the neutral wire can be smaller than the others, but in practice this is very rarely done except in very large plants. Should all the burning lamps be on one side the dynamo on that side does all the work, the other running idle, but as the other lamps are turned on it goes to work in proportion to the number switched in.

2. How are dynamos run in series?

ANS.—Putting in series is placing the positive brush of one dynamo (or positive wire of a battery) in connection with the negative of the next machine, and in this way we add voltage or pressure, something we cannot do with steam pressure, and which comes under the head of difference of potential.

3. What is meant by ampere turns?

ANS.—One ampere passing once around a piece of iron, or in other words, making one turn around the iron, is called an ampere turn. So if we wind 200 coils around a magnet (or just an open coil, i. e., no iron in centre, called a core) and send 200 amperes through we have 2×200 equals 400 ampere turns. The same effect is produced by 800 turns and $\frac{1}{2}$ an ampere, or 40 turns and 10 amperes, just as volts $\times$ amperes makes watts, and many combinations produce the same result.

4. What are the main portions of a dynamo?

ANS.—It may be said that a dynamo consists, first of a magnetic circuit, which is completed by a body of iron which carries copper conductors and revolves across or in the magnetic current at one point. Take, for example, a plain horse shoe magnet and revolve a disk of iron between its poles, the disk being covered with insulated wire. The magnetic lines flow, or find a path, through the disk, and the revolving wire "cuts" or passes through the lines, and electric currents are set upon the wire. In practice the permanent horse shoe magnet gives way to electro-magnets, on account of greater strength of magnetism. The armature core is made up of pieces of soft sheet iron on which is wound insulated wire for conducting the current to the brushes.

5. How are dynamos calculated for different service?

ANS.—As a start we may say that one volt is produced by the armature wire "cutting" or passing through 100,000,000 magnetic lines per second. For example, we have an armature with the length of wire on each side 10 inches, and having 500 turns of wire on the armature. This revolves in a field of 100 square inches area, and the magnetism is 20,000 lines per square inch. Then there are $100 \times 20,000$ lines equals 2,000,000 lines in the field. Now, 500 turns of wire will cut 500 times as many lines per second as one turn would, and be equivalent to $2,000,000 \times 500$ equals 1,000,000,000, which, divided by 100,000,000 equals 10 volts for each turn per second, and running 25 turns per second, or $(60 \times 25 \text{ equals } 1,500)$ 1,500 per minute will give 10×25 equals 250 volts pressure from such a machine. The magnetism is calculated from the ampere turns and the quality of the iron, and is not so certain as the voltage unless you know the quality of the iron. This calculation involves too much mathematics for us at this time.

6. What is alternating current and what is direct current?

ANS.—The power is the current as generated in an armature without connection, and consists of waves which go both above and below a medium line, or, as we usually say, it goes "first in one direction, then back again." The direct current is corrected from this by collecting all the waves at their points and taking them off along the line to their work. In passing from one pole piece to another the direction of current is reversed in the wires, and it is while the wire is in the so-called neutral space between

the poles that the current should be taken off; that is, after it has gathered all the electricity from the lines cut, they are conducted away before their direction is reversed.

7. Of what use are the carbon points that are used in the Westinghouse circuit breaker, or do they form part of the carrying circuit?

ANS.—The carbon contact points and plates in the Westinghouse circuit is of great value and forms a very ingenious arrangement for preventing injurious sparking when the circuit is broken. The carbons remain in contact after the metal contacts are broken, and so carry the current instead of the metal, and thus relieve the metal of any spark, and as the spark does not hurt the carbon materially, it does no harm at that point, although the carbon points can be very readily renewed. This saves the metallic portions of the switch from discoloration and also prevents the unsightly marks on the marble switchboard which are apt to be made with the ordinary switch. The carbons carry the whole current only after the metallic contact is broken.

8. Of what use is a rheostat in the connections of a dynamo?

ANS.—The rheostat is placed in the field circuit and is used to regulate the magnetism of the field by allowing more or less current to flow around the field magnets. If the speed should drop a little you can cut out a little resistance, allowing more current to flow, getting more magnetism, and this produces a higher voltage. Also, when the load is suddenly increased or gets up to nearly the limit of the machine, the voltage is apt to drop a little unless it is compounded, and the rheostat allows you to vary the field strength and consequently the voltage.

9. What is meant by "burning out a cross on the line?"

ANS.—This is something that is seldom done in practice now, but consists in sending enough current through line wire to melt the wire which forms the cross or connection from one wire to the other. Assume that the two wires of an arc circuit are side by side and a small bare telephone wire drops across both wires and makes connection through a break in the insulation of each. Now, if we send enough current through to melt the small wire, the cross or connecting wire, and then relieve the cross. This is not recommended as modern practice, however, and removing the wire is the more modern way of keeping a line clear.

10. I have a shunt wound dynamo which I wish to run as motor; how shall I connect it to have it run the same way as at present, as I do not want to change the brushes?

ANS.—Connect it exactly the same as at present, for if the current flows in the same direction through the armature, the current will flow through the field in the opposite direction and thus make the poles different from the dynamo. Study this out, as it makes a good study and will help you with other problems.

11. How does decreasing the voltage increase the amperage?

ANS.—Transforming does not alter the total amount of electricity (volts) except what is lost in the transformation, and as the pressure (voltage) decreases the quantity must increase to keep this value constant, just as using a crowbar in prying a huge stone or heavy weight we move our arm (the pressure) through a long distance to accomplish a very small rise to the weight, but the total work is the same in each case. In the case of the transformer the voltage multiplied by the amperage of the secondary equals the voltage multiplied by the amperage of the primary (less the loss in the transformer). In the case of the crowbar the distance the weight was raised multiplied by the weight raised equals the distance the long end moves multiplied by the power applied less the loss in friction.

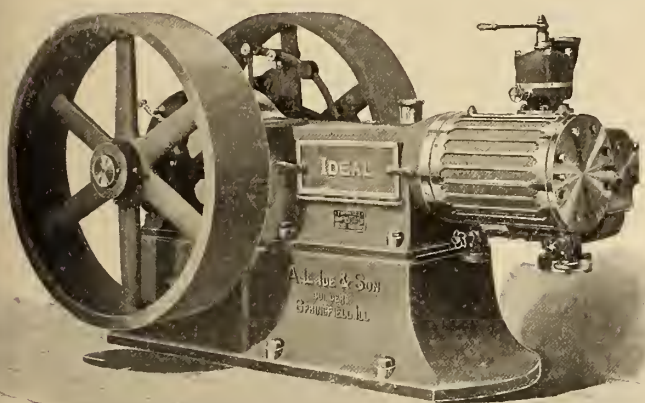
12. What is induction?

ANS.—In the case of electricity it is the current caused or "induced" by the passage (or variation) of current in another wire without actual contact. The transformer is entirely dependent on the induction principle, as there is no contact whatever between the primary and secondary coils. Some of the later alternating dynamos and motors work on the same plan and have no actual contact, but transfer current from the stationary portions to the moving ones solely by induction. The secondary current is said to be induced by the primary, and is often called the induced current.—The Tradesman.

The Canadian General Electric Company have closed a contract with the Toronto Electric Light Company for an additional 450 kilowatt generator to be installed in their new power house. This machine will be a duplicate of that already supplied by them to the same company, in satisfactory operation for some weeks past, being of the belt-driven type and running at a speed of 300 revolutions per minute.

THE "IDEAL" STEAM ENGINE.

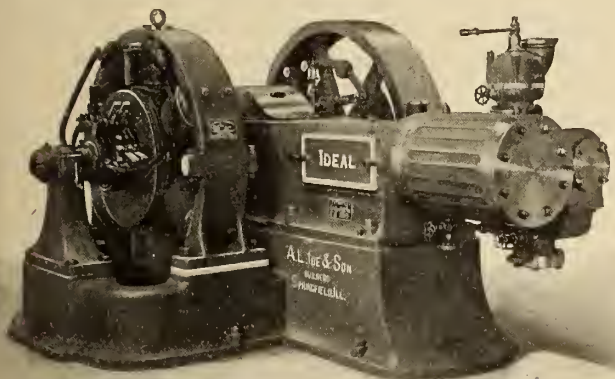
THE three cuts which appear on this page illustrate the "Ideal" steam engine, which is manufactured in Canada exclusively by the Goldie & McCulloch Company, of Galt, Ont. It is an automatic self-oiling engine, and is built for direct connection to slow and medium speed dynamos, for electric lighting and street railway service. The manufacturers claim that it is especially adapted for direct connection because of its range of speeds, quiet running, absolute regulation,



SINGLE CYLINDER "IDEAL" ENGINE.

perfect balance, compactness and absolute lubrication, insuring cleanliness and reliability.

The details of construction are as follows: Cylinders cast of hard, close-grained charcoal iron, finished smooth and receive a high polish. The steam chest is lined with a pair of hard bushings with bridges across the ports, and fitted with the well-known piston type of valve, which is ground to its seat and perfectly balanced. The crank shafts are of larger diameter than usually found in practice, the shaft and disc being cast of gun metal in one solid piece, with open hearth steel center; the crank pin is of tool steel, ground to gauge, and pressed into the discs under hydraulic pressure, ranging from 25 to 50 tons pressure; the cross head is of steel, fitted with bronze slides and removable hardened steel wrist pin; the piston rod is steel and is secured to cross head by thread and massive jam nut; the connecting

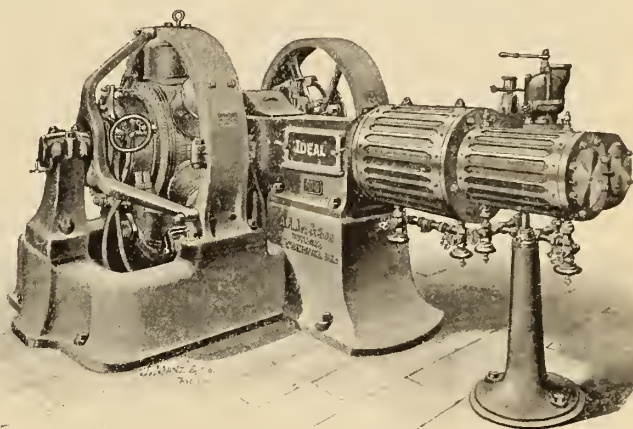


DIRECT CONNECTED "IDEAL" ENGINE.

rod is likewise of steel, and tested in special testing machines at six times the working strain. The levers of governor are steel and bushed with phosphor bronze bushings. The cylinders are encased in a handsome paneled iron jacket, with raised surface polished; space between cylinder and jacket filled with non-conducting material. The automatic cut-off governor is simple; the range of cut-off is wide and enables the engine to

carry a load largely in excess of rating, as the point of cut-off is automatically extended to three-fourths stroke when an increased load requires it. This is considered an important feature in electric railway work, for should the load be unexpectedly increased 50 per cent. for a few hours during the run, as is frequently the case, the engine readily meets this extra requirement. The bearings are cushioned on a film of clear oil.

This engine has a unique system of automatic lubrication. The crank disc is covered by a light hood, fitted absolutely oil tight to the top of the engine frame, but without bolts or fastenings of any description; it is therefore readily removed. The crosshead and guides are likewise fully enclosed, but a side plate for obtaining ready access thereto is also fitted oil tight and held in position only by two cam handles, a quarter turn of which releases it. The engine is consequently more accessible than the ordinary center crank engine, having oil-fenders attached in the usual way; yet no oil can get to the belts or floor. The enclosure is dust-proof, no oil is wasted, the crank-disc dips only about one inch into the oil and none of the parts are submerged. The motion of the discs delivers it by centrifugal force into the pocket extending across the inside of the hood and through a pipe attached to the hood into the oil pocket, through which the oil is carried down in streams



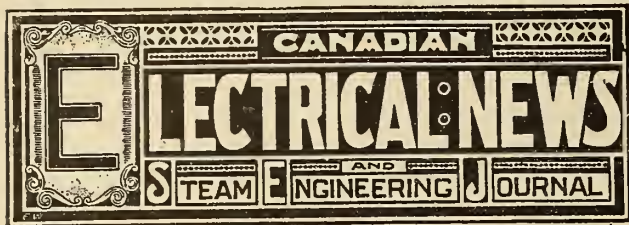
"IDEAL" TANDEM DIRECT CONNECTED COMPOUND ENGINE.

to the crank shaft bearings, and thence through the crank-pin to its bearings and back to the oil chamber under the crank disc. The journals are consequently getting copious, positive and visible lubrication all the time. The clogging of the cups cannot occur, as the oil flows constantly in streams through large pipes connected with the oil pocket in the hood.

The "Ideal" engine, both simple and compound, is noted for quiet running, being entirely free from vibration. The one used at the World's Fair at Chicago for running the electric generators which operated the electric cranes and movable sidewalks, made the phenomenal run of 743 hours, with but one application of oil and without a single stop. Some of its advantages are that steam is used quickly; it occupies less room; is impossible to run away, for should any part of the generator break the engine will stop; power is applied without the use of speeding-up devices; and ease with which generators can be placed direct on the shaft.

The manufacturers will be pleased to furnish further particulars to interested persons.

The town of Barrie, Ont., are considering the question of controlling their electric light plant.



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Electrical Conventions

The Executive Committee of the National Electric Light Association of the United States has chosen Niagara Falls as the place of the next annual convention. The Canadian Electrical Association have already decided to hold their next meeting at the Falls during the month of June.

Cheaper than Gas. The Toronto Electric Light Co. announce a reduction in the price of lighting for residence purposes only, of

33 1/3 per cent. The reduction is put in the form of discount for prompt payment. The discount, which was formerly 40 per cent. is now 60 per cent. This reduction appears to place the cost of electric light a shade below that of gas, even at the low charge of 90 cents per thousand feet, the figure at which it is supplied in Toronto. At 90 cents per thousand feet the cost per hour of the gas consumed by a five-foot burner would be about 4 1/2-tenths of a cent, while the cost of operating a 16 c. p. incandescent lamp under the new tariff would be only 4-tenths of a cent.

Fire Risk in Central Stations.

The recent destructive fire in the Toronto Electric Light Company's premises, should cause the minds of owners and managers of electric stations to revert to our recent remarks on the subject of "Central Stations as Fire Risks." In view of the danger incident to the use of high currents, and the disposition of the insurance companies to put electric stations in the category of most hazardous risks, and charge accordingly, every owner and manager of a central station should be able to see the wisdom of adopting every possible protective device. In the first place the building in which the electrical

machinery is installed should be made as nearly fire-proof as possible. New buildings which are specially put up for the purpose should in every case be built entirely of fire-proof materials. Secondly, there should be supplied the most efficient form of lightning arresters and other protective devices. Thirdly, employees should be compelled to keep the premises in as perfect a condition of cleanliness as possible. We heard of a case not long ago in which a large and valuable plant had a narrow escape from destruction by fire due to a dirty lightning arrester, a switchboard reeking with all the different varieties of oily, greasy filth which accumulate in a slovenly power house and a loose wire.

CONSIDERABLE public opposition is being manifested to the application of the Canadian Niagara Power Co. for an extension of time in which to fulfil their agreement with the Ontario government for the construction of works on the Canadian side for the utilization of the power of Niagara Falls. The wonderful development which has taken place during the last five years on the American side, culminating in the successful transmission of electric power to Buffalo, has opened the eyes of our people to the value of the exclusive privilege granted several years ago by the Ontario government to the Niagara Power Co. It is very properly felt that the construction of the necessary works for the utilization of the power of the Falls on the Canadian side, is of far greater importance to this country than the payment of \$25,000 per year by the company to the government for the retention of the monopoly which they at present enjoy. At the time the agreement was made with the company, the commercial practicability of the generation and transmission of electric power on so large a scale as exists at Niagara to-day had not been demonstrated. When the plans of the Cataract Construction Co. were announced, the gravest doubts were entertained even by persons best competent to comprehend the situation and estimate the chances of the success of the enterprise. Under these circumstances it was reasonably considered that the Ontario government had made a satisfactory bargain. In the light of what has since been accomplished, it is felt that the bargain is not a good enough one to be continued on the same terms. Canada wants a share of the manufacturing industries which are likely to be attracted to Niagara Falls. A prominent Toronto manufacturer makes the statement in the public press that certain New York manufacturing concerns are prepared to erect large factories on the Canadian side of the river as soon as the power shall have been made available. We understand that it is not the desire of the Canadian Niagara Power Company—which is another name for the Cataract Construction Co.—to begin construction work in Canada until such time as they shall have disposed of well-nigh all the power which their present works on the American side will generate. This point may not be reached for several years. Are Canadian interests to lie dormant during this period? It is for the Ontario government to decide. If, as has been stated, Canadians are prepared, in the event of the American company being deprived of their present monopoly, to construct the works, now is the time for a bona fide offer to be made to the government. If the government should deem it wise to grant any extension of time to the American company, such extension should be a short one, and the company should be

required to give therefor a quid pro quo either in the shape of cash, or what would be preferable, a surrender of some of the exclusive privileges which were granted to them.

Electrical Engineering in Canada.

OUR recent enquiries as to the prospects for electrical engineers in Canada has elicited many interesting and valuable opinions from persons whose knowledge and experience certainly gives weight to their ideas; and, as might be expected, there were replies optimistic and pessimistic. Still, however, it seems to us, the subject is not exhausted. Electrical engineers may properly be sub-divided into three classes: laboratory experts, constructive engineers, and operating engineers; and each of these classes require special knowledge and experience. We are, of course, not taking into consideration the large number of telephone and telegraph engineers, whose province it is to deal with apparatus and problems very different from those handled by engineers dealing with lighting and power currents. The laboratory expert is purely an electrical specialist, not necessarily educated in mechanics or any other branch of engineering. For such, there seems to be a very limited field of usefulness in Canada. The constructive, however, and the operating engineer have a very different and in many respects a far more extended horizon—which will become even wider and more wide as the public arrives at a better idea of what the use of electricity requires. For both a very thorough knowledge of mechanical and of civil engineering is required, in so far as those branches include steam engine practice and railway construction. The constructing electrical engineer who does not include within the range of his professional knowledge the principles of engine and machine design which are absolutely necessary in the efficient planning of a complete plant; or those principles of track construction (rails, their proper weights, sections, etc., and road-bed) without which a railway becomes a mere tram road, is really failing in his responsibilities; while the operating electrician who is not thoroughly versed in the principles of steam generation and utilization, as well as in electrical matters, is really shutting his eyes to the main feature of his duties. Hitherto it has not so much been that the public does not appreciate knowledge in its employes; but the employes themselves have not understood their duties, and while claiming to be electrical engineers, electricians and so on, have been no more than mechanics, with a smattering of dynamo tender's knowledge. It is at least a reasonable guess, that in Toronto there are many score young doctors and lawyers who have not the faintest prospect of ever earning \$75 a month, who might have done certainly as well as superintendents of electrical plants; and although Josh Billings once advised "It ain't safe to prophecy unless you know," still we presume to say that in future few engineering enterprises, whether light, power, railway, mining or electrolytic, will be undertaken without the assistance of an electrical engineer; and that the lighting plant of 1,000 light capacity that is not either directly or indirectly in charge of a properly educated electrician will be a rarity, and losing money. Let electrical engineers shew what they can do, instead of wailing that there is no prospect, and the public are sharp enough to know a good thing when they see it.

CORRESPONDENCE

THE DUTY ON ELECTRICAL MACHINERY.

To the Editor of the CANADIAN ELECTRICAL NEWS.

SIR,—It was with great interest that I observed, recently, a hint thrown out by the tariff commissioners, that the duty on electrical machinery might be at least reduced if not quite abolished. I cannot help thinking that such a course would be greatly in the interests of the Canadian public, who at the present are paying a considerable sum every year to support an industry that has no real "raison d'être." Nor can I think that the larger and more reputable manufacturers would have any well-founded arguments or objections against it. One manufacturing company exploiting a very favorably known make of dynamo, finds itself obliged to import a considerable portion of it, the necessary materials, etc., not being obtainable in the Dominion. On these imported portions a large duty is levied, which obliges the company to charge a higher price without in any way benefitting thereby. Speaking in the most general terms, there seems to be no good reason why the electrical manufacturing industry should be protected in Canada. It is entirely an imported industry, and to a large extent supported by American capital. While we have several very excellent colleges giving electrical courses and degrees—still the science of practical electricity is by no means one of Canadian growth, and as a matter of fact we simply follow where Europe and the United States lead. My notion of protective tariff is that it is intended to foster and carefully nurse into vigorous, self-supporting strength, industries which, by developing and consuming the natural resources of a country, may be of permanent benefit to the community, and help a nation's advancement. Taking the whole Dominion, I find that the establishments manufacturing electrical machinery can be numbered on the fingers of one hand, and of these probably there is not a solitary one that does not copy some American patent, or that can truly be said to represent a thoroughly Canadian industry. Do five manufacturing companies, mostly small, constitute an industry? and yet these five are protected, to the prejudices of the whole country, by a 25% duty. Take carbons—there is one carbon factory in Canada; there are, we may truly say, hundreds of purchasers; these hundreds have to pay 25% more than they otherwise would in order that one may live. Has any improvement in carbons, in incandescent lamps, in transformers, in dynamos—in any electrical apparatus—originated in Canada? Are we originators, or imitators? most certainly the latter, and the question is inevitable, "Why protect an imitation, that cannot be said to represent an industry, and which is in the hands of a very few?" Moreover, it has been demonstrated to a certainty in several recent cases, that this protective tariff DOES NOT PROTECT. In at least four instances within the last very few months, to my certain knowledge, machines built in the States have been sold right in the Dominion; the figures, including freight, customs dues, etc., etc., being considerably less—some hundreds of dollars less—than the same size of machine manufactured by Canadian manufacturing companies was being quoted at. The principle of "the greatest good to the greatest number" should point out that if American manufacturers can manufacture so cheaply that they can sell their goods in Canada, paying 25% duty, and even then undersell Canadian manufacturers,

the electrical manufacturing industry in Canada is not worth protecting, and is simply an unjust imposition on hundreds of citizens who are heavily taxed that a few individuals may live.

Yours truly,

JUSTICE.

THE COST OF ELECTRIC POWER.

TORONTO, Feb. 2nd, 1897.

To the Editor of the CANADIAN ELECTRICAL NEWS.

SIR,—You, and no doubt, all the readers of your valuable journal, are at the present time interested in the development and transmission of power by electricity, especially over long distances. No doubt the different electrical manufacturing companies in Canada have figured on developing certain powers, and for the benefit and education of the electrical public in general, I would ask you to publish the enclosed clipping from one of the Hamilton daily papers of a very recent date, which no doubt will furnish food for reflection to the electrical engineers and also show them the errors in cost in figuring on power transmissions in the past.

"Mr. Willson said it had cost him as much to develop his 100 horse power at Merritt as it would cost him to develop 60,000 horse power at the falls, or about \$320,000. So far as he was personally concerned he was interested because with electric power he could produce carbide so much cheaper than at present. The demand for carbide was larger than the supply could possibly be under the present circumstances, the cost of producing 1,000 tons in a year being \$19.31½ per ton. He had orders booked for New York for 11,000 tons at \$80 per ton, and a few days ago he shipped thirty tons of carbide.

"He estimated the total expense of developing 60,000 horse power on the Canadian side of the falls at about \$320,000, or \$533½ per electric horse power for twenty-four hours every day in the year.

"To get 10,000 electrical horse power to Hamilton would cost about \$45,326, requiring a capital of \$321,150. This would mean a cost of only \$4.58 per horse power, but at the first cost it would probably run near \$10.

"Mr. Willson said he believed if electrical power were brought to this city, as it could be brought if the American monopoly were not allowed to continue, Hamilton could control the world in the matter of manufacturing. This would be especially the case if natural gas were utilized with the powers at the fall. No country in the world could produce goods as cheaply as this city could with this electrical energy that the legislature was asked to give away for a paltry and unpatriotic consideration.

"In reply to a question he said Buffalo paid about \$25 per electrical horse power at present, and he presumed it would cost this city that much to get it from the Canadian Niagara Power Company. He thought the legislature should hold the valuable electrical power, and lease it by the year, charging \$1 per horse power for it, instead of allowing it to be monopolized by an American company. The government could make the headrace and establish the developing apparatus at a cost of about a million and a half dollars, without injury to the beauty of the park or the diminution of the water at Niagara."

A TRAVELLER.

WIRE ROPE DRIVING.

The transmission of power by means of a wire rope is apparently a very simple matter, but several laws must be obeyed or the transmission will give trouble from the start. First, the rope should run in the right direction, so as to pull through its bottom fold, letting the top rope lie slack, thereby hugging the pulleys through a considerable arc. The rope should also be driven at as high a speed as possible. The higher the speed the greater the pull upon the rope to a certain extent, but where the speed is high the pull can be less. Just imagine a rope running at 1,200 feet per minute and pulling fifty pounds. If the speed be got up to 600 feet per minute, the rope to do the same work must pull 100 pounds. This makes a much tighter rope necessary, brings more strain upon the rope, the pulleys and the shafting, and more than counteracts the gain in rope life which may be caused by slow velocity.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

NOTE.—Secretaries of Associations are requested to forward matter for publication in this Department not later than the 25th of each month.

TORONTO NO. 1 AT HOME.

THE annual assembly of Toronto No. 1 was held in Engineers' Hall, 61 Victoria street, on Wednesday evening, February 3rd. Over 200 engineers and their friends, many of whom were ladies, gathered in the hall, which had been decorated for the occasion. Mr. J. Fox, president of the Association, performed the duties of chairman, and on the platform with him were Messrs. C. Mosely, vice-president, and S. Thompson, chairman of the special committee. The first part of the entertainment took the form of a concert, a novel and rather pleasing feature of which was the display of juvenile talent. The programme consisted of songs by Miss Dillon and Mrs. Coutts-Bain; readings by Miss Leverty; comic duetts by Messrs. Parker and Daly; club swinging by Mr. Thos. Eversfield; violin solo by Miss Simpson; duetts by the Misses Leverty; musical selection by Master Willie Huggett, and a selection by Messrs. Hordern and Collins. Mr. Harding played the accompaniments, and each artist was well received. Then followed what might be said to be the event of the evening—a clever exhibition of hypnotism by Mr. John Main. The wonderful feats performed proved to the satisfaction of the audience that the subjects were fully under Mr. Main's control, and established beyond a doubt his reputation as a hypnotizer, besides providing much amusement for the audience.

After refreshments had been served, a couple of hours was spent in dancing by those who felt thus inclined. The entertainment passed off most successfully, to the credit of the following committee: S. Thompson, chairman; A. Storer, J. Huggett, M. Mose, W. J. Webb, J. Fox, A. M. Wickens, G. Thompson and T. Eversfield.

OTTAWA NO. 7.

Ottawa No. 7 have elected the following officers for 1897: President, Frank Robert; vice-president, Albert Gaul; recording secretary, T. G. Johnson; financial secretary, Sidney Barnes; treasurer, William Hill; conductor, Thos. Butterworth; door-keeper, Allan Clark; auditors, Thos. Wensley, Frank Merritt and F. G. Johnson. The Association numbers forty members, and is in a satisfactory financial position.

BROCKVILLE NO. 15.

Sir,—On the first evening of last month, Brockville No. 15 was favored with a visit by Bro. F. Donaldson, of the Boiler Inspection and Insurance Co. of Canada, who gave us a very interesting and encouraging talk on the prosperity of the Order of the C. A. S. E. He congratulated the members of the Association on the apparent lively interest they manifested in working out some very difficult problems on the blackboard, which was received with applause. Some suitable remarks were also made by Past-President Bro. Chapman before the meeting closed.

JAMES AIKINS, Rec.-Sec'y.

WOULD NOT BE WITHOUT IT.

Mr. Ed. Bailey, of Ottawa, in renewing his subscription to the ELECTRICAL NEWS for 1897, writes: "It has afforded me some very valuable information during the past year, and I would not be without it for a great deal."

HEAT AND BOILER EXPLOSIONS.*

THE subject of the paper to be read before you is Heat, and its action during the explosion of boilers.

I will first briefly outline the views held as to what heat is, by both ancient and modern philosophers. Following the modern ideas, the mechanical equivalent of heat will be considered. Then the behaviour of water when subjected to heat, and under the usual atmospheric conditions; and further when confined, as in a boiler, where, under ordinary conditions, the water may be subjected to a pressure greater than the atmospheric. In preparing this paper I have endeavored to use only such facts that you can experimentally prove to be true. In calculations, the simple rules of arithmetic are sufficient for our purpose, and technical terms will be avoided as much as possible. If I use the word "theory" it is in the sense of being a generalization of facts, and the word "energy" in its mechanical definition must be used; there is no equivalent for it in our language. Energy means "capacity for performing work," and according to this definition may be either at rest or in motion, or, as the books say, either potential or kinetic, or, what is the same thing, either possible or actual.

As an illustration of how the term energy is used, and which must appear in this paper, especially when a boiler explosion comes in order. At noon you shut down your engine. The steam may then be 50 or 60 by gauge; notwithstanding this pressure the whole system is at rest; there is no visible motion. It cannot be denied that there is a capacity for performing work still in the boiler. It is possible, and is therefore called "potential" energy. Open the throttle valve; motion of the engine takes place, and a part of the potential energy stored in the boiler becomes kinetic or actual, as stroke after stroke is made by the engine.

It is natural for the human mind to assign some cause for every effect observed. The common belief of the ancients was that heat was a material substance that permeated the small spaces between the minute particles or atoms of matter, and they called it caloric, a name retained at the present time, but with a somewhat changed meaning. There never was the least direct evidence to support this belief. It was one of the results of a pernicious fallacy then believed, that there was a double system of natural laws, one theoretical, the other practical. The philosopher made this theory as he called it, and then twisted the facts to an agreement with it. Under such a system no scientific advance could be made.

This was the received opinion about heat for over 2,000 years. Yet during this time a writer occasionally appeared that doubted it, and considered heat to be simply a mood or condition of matter. But, true to the theoretical ideas of that time, no proofs were advanced. About one hundred years ago, Benjamin Thompson, afterwards known as Count Rumford, took the question in hand. He was a native of Concord, in Massachusetts, and for his loyalty to King George during the American revolutionary war, he was obliged to leave his country. After some years he turned up as superintendent of a military arsenal in Germany, where his attention was directed to the great amount of heat generated during the boring of brass cannon. He experimented and measured. The question was in the hands of a master. The results were made public in a paper read before the Royal Society on January 25th, 1798. The scientific men in all countries have accepted his conclusions. It is said this was the most important paper ever read before this learned society. It established what is now called the mechanical theory of heat. Reasoning on his experiments, he came to conclusions that have been accepted as final, that heat is not an igneous fluid, but a form of atomic or molecular motion, and if a motion, there must be a mechanical equivalent at work.

We all know what a hot journal is, and at least some of the causes. We all know that heat is generated and the temper taken out of a chisel or drill if sharpened on a dry grindstone. Lay a small bar of iron on an anvil and strike it a smart blow with a sledge. Where impact took place it is found to be sensibly warmer than at any other part of the rod, and a second blow on the same place makes it warmer still, in fact it can easily be made red hot. Those who have witnessed tests of armor-plates for warships tell us that when the projectile struck the plate there was a brilliant flash of light, and on examining the hole made in the plate it was found that the metal had been fused. To come down to a small matter, although there is no great or

* Paper by Capt. James Wright, read before Montreal No. 1, C.A.S.E., January 21st, 1897.

small in nature, when I was a boy going to school in Scotland, amongst the equipment to stocks and stores found in every boy's pouch, there was sure to be a good sized brass button. Brass buttons were then fashionable on male attire, so they were easily got. By rubbing this button on a desk or form heat was generated, and, if then applied to the neck of the boy that sat next to him or in front of him, would give him a start. Often the master's taws supplemented this affair, and I have seen battles fought on the play green to settle the little matter. In doing this trick, the boy was unconscious that he was illustrating one of Nature's great truths, the conservation of energy by the transformation of work into heat. But he was well aware that the longer he rubbed and the greater the pressure he put on the button the hotter it became.

Following the reading of Count Rumford's paper, it became an important problem to establish the correct relationship between heat and mechanical work. During the early part of the present century many tried but failed. At last, about the year 1840, the question was independently taken up by Joule, an Englishman, and Mayer, a German, of whom it has been said Joule worked the theory out, and Mayer thought it out, and both gave it the solidity of demonstrated truth. This great question took this form: What weight lifted one foot high is equivalent to the warming of one pound of water 1° F.? As it was then and is now, the unit of heat is the amount required to raise one pound of water one degree in temperature. Joule worked or experimented for seven years in the basement of a storehouse in Manchester that was noted for the uniformity of its temperature throughout the year. At first his results were widely different, but as his experience increased, they became closer. At last, in 1849, after applying all the precautions suggested by seven years' experience, the result of 110 experiments made on water, mercury and cast iron, was that the mechanical equivalent of the unit of heat, was the lifting of 772 pounds one foot high, or what is the same thing, the lifting of one pound 772 feet high.

Mayer adopted an entirely different course. The data from which he calculated the mechanical equivalent of heat was obtained from the increased amount of combustible consumed in heating air which expanded against the atmosphere and performed work, above that consumed in heating the same weight of air to the same temperature in a closed vessel which resisted expansion, and no mechanical work done. Mayer perceived that the difference in the combustible consumed, or more properly the heat utilized in producing the same thermal effect on equal weights of air, and under the above different conditions, was the heat equivalent of the work done; and from this he calculated that the mechanical equivalent of the heat that would raise the temperature of one pound of water one degree F. was the lifting of 771.4 pounds one foot high, or about ten ounces less than Joule's equivalent. This extraordinary coincidence removes any doubt of its accuracy; and it is rightly considered the greatest scientific discovery of the century.

It is an acknowledged truth in modern science and confirmed by all experience, that energy or the capacity for performing work cannot be annihilated. The amount in the universe, possible and actual, remains the same under every change which may arise. But it changes its form of action. Under certain conditions it appears as heat or light: under others as mechanical, electrical or chemical energy, besides many other forms. Still conservation is the law which binds the whole together. We have a good example of this in the street railway system in this city. There is a pile of coal and a supply of water at one end of the system; a hundred or more moving cars at the other, with a wire connection between. The method of doing this is foreign to the subject of this paper, the main purpose of which is to trace the causes which lead to a boiler explosion, and the destructive effects which accompany or follow it, without any hypothetical suppositions about unknown forces which cannot be proved to be present. In fact, it will be seen that when a boiler explodes it is simply obeying the usual laws under which it acts when supplying steam to an engine, or to heat a building.

Following up the lines laid down at the beginning of this paper, the effect of heat upon water under the usual atmospheric conditions now comes in order. In this country we are acquainted with water in the form of a solid, a liquid, and steam. It is generally said that water freezes at 32° and boils at 212°. The last figure is not quite correct at all times; it depends upon the atmospheric pressure which varies from day to day. But it would be inconvenient to be talking in fractions all the time, or having to read a barometer before making an assertion. It has been agreed

upon that under the ordinary atmospheric conditions these figures be accepted.

On a day when the temperature is below 32°, put a thermometer in a pail of warm water, and set it outdoors in an exposed position; then observe its gradual fall in temperature. Repeat this as often as you please; vary the conditions; let the temperature of the atmosphere be zero, or 10, 20 or 30 degrees below. You will find that water in the liquid form never falls below 32°. At this point there is a halt, and only after becoming a solid, or ice, does the temperature fall below 32°. Again, put a thermometer into a quantity of water in a pot, and put it over a fire in a stove. Now observe what takes place. The temperature rises until 212° is reached. Here again a halt takes place. The water boils, steam is formed. Hold the thermometer in the steam; its temperature is also 212°; and as long as any liquid water remains in the pot, its temperature never rises above 212°. It makes no difference what the temperature of your source of heat may be, the result is the same. From this it is evident that the range of temperature in which water can exist in the liquid form, while under the common atmospheric conditions, lies between 32° and 212°. It has been said by the highest authority that water is the most wonderful substance in nature.

So far our experiments have been made in a pail or pot. Unimportant as they may appear, yet in view of what follows in this paper, I beg leave to call your special attention, again and again to the fact, that the highest temperature at which water can exist in a liquid form while under atmospheric pressure is 212°. This fact astonished even James Watt, which shows the state of experimental knowledge at that time. One hundred and thirty years ago he was working as a mechanic in Glasgow College. In the course of events, a model of a Newcomen pumping engine was put into his hands for repair. As a common mechanic, he did the work. Afterwards he tested it, and was amazed at the enormous quantity of steam it used. In his efforts to discover the cause of this he found that he could not raise the temperature of water in an open vessel above 212°. He was enlightened on this subject by Dr. Black, one of the professors. Dr. Black had previously discovered the same thing, put it in a scientific form, and was then teaching the principles of latent heat to his classes that all matter in passing from the solid to the liquid form, or from a liquid to a vapor, absorbed an amount of heat that was not sensible to a thermometer, and was hence called latent, but could be proved to exist by a reversal of the process. After this consultation Watt returned to his shop in the college and contrived a means of making special and quantitative experiments on latent heat. He decided that the latent heat of steam at a sensible temperature of 212° was 945. Or, in other words, that the latent heat, set free by one pound of steam at atmospheric pressure, in passing to the state of water at 212° also, would raise the temperature of 945 pounds of water one degree. Considering the then imperfect means at Watt's disposal of solving this question, it is wonderfully close to the now accepted figure of 966. It is well known that Watt, in tracing the causes which led to the wastefulness of the little model, invented the separate condenser, the first of that brilliant series resulting in the steam engine, and effecting in a peaceable manner, the greatest revolution that ever took place on earth. To sum up the above thermal results: Under atmospheric pressure, water in the liquid form can only exist between the temperatures 32° and 212°. In the solid form, or ice, the temperature can fall below 32°. In the form of steam the temperature can be raised above 212°, in which case it is said to be superheated.

Next in order comes the thermal behavior of water, when subjected to a pressure greater than the atmospheric, as we see in a boiler. This part of the enquiry will lead us directly, and at once, to the origin of the mighty force at work during the explosion of a boiler. For clearness and precision of statement, in the line I propose to pursue, I have considered it best to select some boiler for reference. Any one would answer the purpose; but I happen to have in my possession the drawings of a common horizontal tubular boiler, with all the calculations required for our present purpose. This boiler is 66 inches in diameter and 14 feet long, with fifty-nine 3½ inch tubes. The calculations are based on a working pressure of 100 pounds by gauge, and at a time when there was 4½ inches of water over the top row of tubes. Under these conditions there is 181 cubic feet of water in the boiler, and 97 cubic feet of steam room. As was stated in the beginning of this paper, I will endeavor to use only those facts that you can experimentally prove. Take this boiler when empty and drill a hole in the water space and another in the steam space.

Tap the holes and screw in boiler thermometers. These are nothing but common thermometers designed for this purpose. When in place the bulb is in the interior of the boiler; the stem and the graduation is outside, where it can be read. After this is done put in a proper charge of water; put the safety valve in place, and hang the weight at a point where it will balance an internal pressure of 100 by gauge. Then start the fire. At first the two thermometers may not read alike, the conditions are different; but they soon read the same. It will now be observed that the temperature of the water gradually rises. As it approaches 200°, there is a noise in the boiler. This is the same action as the singing of a tea kettle, only on a larger scale. Presently the water thermometer reads 212. The boiler is now comparatively quiet. In a short time the finger of the gauge reads 5. At this time the reading of both thermometers is 228°, or 16° above the highest possible temperature under atmospheric pressure alone. Now carefully note the pressure and corresponding temperature as steam is getting up. With gauge at 30, both thermometers read 274°; with gauge at 60, both thermometers read 307°; with gauge at 100, both thermometers read 338°. These are the boiling points, or temperature of ebullition corresponding to the given pressure, and prove that as the pressure increases the boiling point rises. And also that under all circumstances, at least as long as the steam is in contact with the water from which it was generated, the temperature of the steam and the water is the same. These results are immutable. The water contained in the accumulator in the Board of Trade building, when subjected to an air pressure of 100 pounds per square inch, would not boil until a temperature of 338° was reached.

In following up the line of argument pursued in this paper it is convenient to know what is fairly the weight of water, and what is the weight of steam contained in this boiler. Under usual working conditions, when the water is 4½ inches above the upper row of tubes, and steam at 100 by gauge, we found the water space to be 181 cubic feet. This volume of water, at a temperature of 338°, weighs 10,140 pounds; and the 97 cubic feet of steam, that being the steam space in the boiler, weighs only 25½ pounds. In this case the weight of water in the boiler is 397 times the weight of the steam. Numerical results sometimes surprise us, but we must accept facts as we find them.

Preliminary and other preparations being made, we now confront the main question, the explosion of a boiler and how it is effected. If our selected boiler with 10,140 pounds of water in it at a temperature of 338° was suddenly relieved from a large amount of its internal pressure of 100 pounds per square inch, what would take place? The conditions under which water formerly existed as a liquid in the boiler are gone, and it will of necessity lower its temperature in conformity with the decrease in pressure. In falling to atmospheric conditions, as it must come to this in all explosions, each pound of water drops 126° in temperature, and in 10,140 pounds of water, 1,277,640 heat units would be liberated. Now, what becomes of this heat? Energy is indestructible. It may take other forms, but cannot be annihilated. This heat is utilized in the formation of steam. There is nothing hypothetical in this. It can experimentally be proved to be true, and we see it every day. When water comes from the try-cock of a boiler under pressure, as soon as it is subjected to atmospheric conditions, it generates steam, and a large volume, too, compared with the small quantity of water. But the same thing is seen to better advantage, and can be studied at the out board end of a blow-off pipe during the operation of blowing off a boiler. Look at the great volume of steam formed after exposure to the atmosphere, when nothing but water under pressure came from the boiler. It is a fact that during the operation of blowing off a boiler, and an explosion, the same process is gone through, the difference in the effects being due to the difference in the time it was done.

The weight of steam made under the condition of a sudden fall in pressure can be computed between any named pressures or temperatures. In the present case I prefer to take it from the working to the atmospheric temperatures, or from 338° to 212°, and also using the former data.

Temperature of water previous to explosion	338°
Temperature after explosion	212°
Heat rejected per pound of water.....	126 units
Total heat or steam at 212°	1,277,640
Original temperature of water.....	338°
Units of heat required to form one pound of steam.....	840 units.

This amount of heat is furnished by 6¾ pounds of water in falling from 338 to 212°, or one pound of steam is under the circumstances formed in every 7¾ pounds of water. Dividing the

10,140 pounds of water in the boiler by 7¾ we obtain 1,322 pounds of water converted into steam by the sudden loss of 100 pounds pressure per square inch in the boiler. This is astounding. We found only 25½ pounds of steam in the boiler when in working order, and now during an explosion 1,322 pounds is accounted for. Most of you must think that I am in error here. If so I cannot detect it. On the principle of the conservation of energy, I tested it in this manner. Previous to the explosion there was 10,140 pounds of water in the boiler at a temperature of 338°; total units of heat in the water, 3,427,320. After explosion there was 8,818 pounds of water at a temperature of 212°, and 1,322 pounds of steam at a sensible temperature of 212°, but a total heat of 1,178°.

Units of heat in 8,818 pounds of water at a temperature of 212°....	1,869,416
Units of heat in 1,322 pounds of steam under atmospheric conditions	1,557,316

Total..... 3,426,732

In working this out, I paid no attention to the fractions in the table. Yet the difference in the heat units before and after explosion is only 588 in these large amounts. The conservation of energy here holds good, and obtaining this result, I had no hesitation in laying it before you. I have intentionally omitted saying anything about the 25½ pounds of steam that was in the working boiler. Its effect on the results is comparatively insignificant, and for simplicity, I said nothing about it. Also, I wish to observe, that in making the last calculation, it was based alone on the actual transformation of heat energy, from the sensible to the latent form, which then took place in the boiler after a sudden loss of internal pressure.

This loss of internal pressure generally results from a failure of the boiler to resist the stress it was subjected to. In other words it was not strong enough. A rent, rupture or collapse takes place. An opening is made. If small the boiler may peaceably discharge its contents; but if large enough to permit an immediate and material fall in the pressure, enormous forces are liberated, an explosion follows, and all in strict conformity with natural laws, which are observed every day in a boiler house.

It may be thought that my method of calculation is obscure, in finding that 1,322 pounds of water at a temperature of 338° would change its liquid form into steam at atmospheric pressure, when the boiler pressure of 100 pounds by gauge was lost. I will put it in another form. As already stated there is 10,140 pounds of water in the boiler at a temperature of 338°. In falling to a temperature of 212°, or atmospheric conditions there is 1,277,640 of heat units liberated, which is taken up as latent heat by a part of the water becoming steam. The latent heat of one pound of steam at atmospheric pressure is 966 heat units. Dividing the total heat units liberated, viz., 1,277,640 by 966, we again obtain the same number 1,322, which is the pounds of water evaporated from, and at 212° by 1,277,640 units of heat. All such questions admit of an approximate solution in a practical manner. The fireless locomotive is an example, where water, in falling from a temperature of 400 to 260° furnishes steam to do the work for a limited time.

I must now come to a close. My purpose in writing this paper to be read before you, was to trace the origin of the forces at work during the explosion of a boiler, and go no further. We have seen the changes which must take place in the thermal conditions of the water in a boiler in following a sudden fall of pressure from 100 by gauge to atmospheric pressure. At the same time, the total units of heat remains the same notwithstanding the change of form in energy. But this is not all. What would be the result when the pressure has fallen from 100 to 80? Over 160 pounds of water would be converted into steam, an amount more than six times the weight of steam in the boiler under working conditions. This seems to prove that an explosion may, under certain conditions, instantly follow a rupture or failure of the boiler, although there are authenticated cases where it did not, and several seconds intervened between the failure of the boiler and explosion, as witness that case in a Denver hotel the year before last.

The engineers of 60 or 80 years ago were much perplexed in accounting for explosions. They theorized, as it was then called, and talked nonsense about explosive gases, invisible lightning, and the miraculous ability of red hot plates to make steam. But in one thing they were correct. They observed that under the same pressure, the destructive effects of explosions was in proportion to the weight of water in the boiler.

Don't attempt to run a shaft in a box that is too large or too small, as you will waste time and fail to secure good results.

THE LATE E. CARL BREITHAAPT.

IN common with his many friends in the electrical fraternity, we are called upon to express our deep regret and sorrow at the untimely death of the late Mr. E. Carl Breithaupt, of Berlin. Most of our readers are already familiar with the tragic particulars of his death. In his capacity as manager of the Berlin Gas Works, he was supervising the emptying into tanks of several barrels of coal oil, which it was the intention to use as a temporary substitute for the crude oil usually employed in the manufacture of gas, when it is supposed the gas rising from the tank came in contact with the flame in a lantern which Mr. Breithaupt was carrying, causing an explosion which resulted in his death and the death of the electrician. The latter was killed instantly, but Mr. Breithaupt lived for six or seven hours, during which time he recovered consciousness, and was able to bid good-bye to his sorrowing relatives.

By this lamentable occurrence the light of a useful life has been extinguished, and the shadow of a great sorrow has been cast upon many hearts. The large attendance and many tokens of esteem which marked the obsequies, were but an index of the high regard in which the deceased was held by all who had the honor of his acquaintance.

The late Mr. Breithaupt was cut down in early manhood, being only 30 years of age. Deceased was the fourth son of the late Louis Breithaupt, mayor of Berlin in 1880, and was also a brother of the present mayor, Mr. J. L. Breithaupt. He was a native of the town in which his death occurred, and there received his early education. Subsequently he attended the Northwestern College at Napierville, Ill., and Johns Hopkins University at Baltimore. At the latter institution he took a thorough course in electricity, and graduated as an electrical engineer. About six years ago he returned to Berlin, assumed the management of the gas works, and also began practice as a consulting electrical engineer.

He had recently purchased a controlling interest in the Berlin and Waterloo Street Railway, of which he also undertook the management. Under his direction it was reconstructed and transformed into an electric road. During the past few months handsome new cars and other modern equipment had been added, and the power station was about to be extended with the view of putting the line in the best possible shape for business next season.

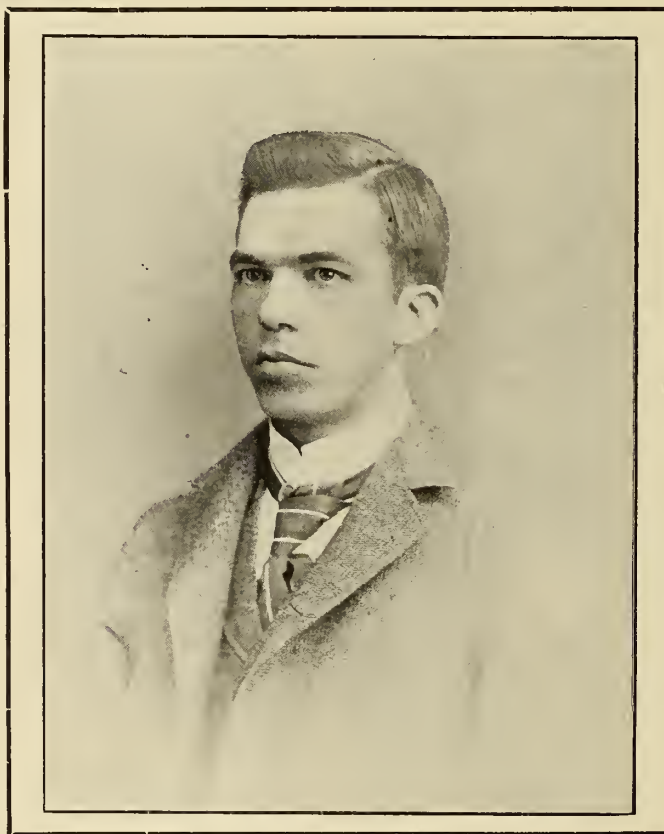
The deceased was a past president of the Berlin Board of Trade, a member of the Toronto Board of Trade, and actively interested in the advancement by

every means of the welfare of the community in which he lived.

In the death of Mr. Breithaupt the Canadian Electrical Association has sustained a very serious loss. From the earliest days of the Association he had manifested the greatest interest in its welfare, and by every means in his power advanced its prosperity. In addition to rendering valuable counsel and assistance as a member of the Executive Committee, he prepared and presented several valuable papers, and as Chairman of the Committee on Statistics performed valuable service. At the last annual convention he was elected second Vice-President, and had his life been spared, would in due time have been given the highest position in the gift of the Association, for which his genial nature and conspicuous ability so well qualified him.

MONTREAL TELEGRAPH COMPANY.

THE fiftieth annual report of the directors of the Montreal Telegraph Company was presented at the annual meeting held in Montreal on the 14th January. Since the first dividend to the shareholders, on the 14th January, 1848, dividends averaging over 9 per cent. per annum have been paid semi-annually, without intermission till 1881, besides which bonuses on several occasions, ranging from 10 per cent. to 25 per cent., have also been paid. From the formation of the Western Union Telegraph Company in 1866, the closest and most friendly relations have always been maintained between the two companies. On the 17th of August, 1881, accepting the proposal of the late Dr. Green, President of the Western Union Telegraph Co.,



THE LATE E. CARL BREITHAAPT.

to still further harmonize the great telegraph interests of the United States and Canada, the arrangement was consummated and the conditions embodied in the agreement of that date, by which, for a period of 97 years from the 1st July, 1881, dividends to the shareholders of the Montreal Telegraph Company at the rate of 8 per cent. per annum are guaranteed by the Western Union Telegraph Company. By the terms of the agreement, and in virtue of this guarantee, the company continues the payment of quarterly dividends begun, under such favorable auspices, in October, 1881, over fifteen years ago.

The company continues free from debt or obligation of any kind, and has assets of \$2,259,415.

The Chateaugay & Northern (Montreal Island Belt Line) Railway have ordered additional G. E. 1000 equipments from the Canadian General Electric Company.

LEGAL.

We herewith print the full text of the decision of the Montreal courts in the action brought by the Bell Telephone Co. to restrain the city and the city surveyor of Montreal from interfering with the company for the purpose of preventing them from laying underground conduits in the streets of that city.

"The court, having heard the parties by their respective counsel on the grounds of this action; and after having examined the procedure, the exhibits produced and the proof adduced, and having deliberated:—

"Whereas the company defendant declares:—

"1st. That in virtue of the powers granted to it by its charter it placed certain pipes or conduits underground in certain streets of the city defendant, comprising, amongst others, Notre Dame street, from St. John street to Gosford street and from this latter street to Craig street.

"2nd. That on the 22nd April, 1896, said company notified the city by letter that it intended to place conduits in the following streets for the operation of its telephone wires, namely: In Notre Dame street east and west of St. John street and in the streets going in northerly and southerly direction of this street, and also in St. Peter, St. Alexander, St. Charles Borromee and St. Catherine streets, and, to this end, it would be necessary to make excavations in these streets.

"3rd. That the plaintiff requested the City Council to name the inspector (or other official of the city) to oversee and direct such works, and that on the 17th May, 1896, the sub-committee of the road department of said city recommended that the request of the company be granted and it be permitted to place its conduits underground in Notre Dame, McGill, St. Peter, St. John, St. Sacramento, Craig, and other streets.

"4th. That on the 22nd July, 1896, plaintiff was notified by the city inspector (by letter) that the City Council had, by resolution to that effect, authorized the excavations in the streets of the city for the placing of said conduits therein, demanding a deposit of fifteen thousand dollars (\$15,000) as a guarantee that these said streets thus opened would be put back in their normal condition, which deposit was made.

"5th. That plaintiff placed conduits in Notre Dame street, from St. John street east to Gosford street, in Gosford to Craig, in Hospital and St. Francois, Place d'Armes and others.

"6th. That on the 8th September, 1896, said Council passed a resolution giving instructions to the city inspector to stop the work which was being done by plaintiff on said streets, Notre Dame; and from St. Sulpice to Gosford and in all the streets where the works of the plaintiff was being carried on, to take up said conduits and replace the streets in the same condition as they were before and to prevent (by force, if necessary) all works and encroachments on all streets and public places being done without permission of the City Council.

"7th. That the inspector of the city notified plaintiff that it intended immediately to take up from Notre Dame street (between St. Sulpice and Gosford) and from the latter street, all the conduits and other material which had been placed there by the plaintiff, and that said removal mentioned had been commenced.

"8th. That, acting as aforesaid, the Council exceeded its powers, and acted without authority, and that, for the reasons mentioned above, the plaintiff demands that writ of injunction taken out for the protection of its rights be granted.

"Whereas defendant has contested said writ, denying to the plaintiff the right to act as it has done, and denying the powers it invoked, &c., &c.

"Considering that it is shown by the proof, exhibits and documents on record that plaintiff before proceeding with said works (stopped and interrupted by defendant) had conformed to the rules and formalities the latter could demand by the terms, as well of its act of incorporation as by that of plaintiff.

"Considering that plaintiff has proved the allegations (essential) of its request, and specially according to the terms of the charter it had the right to put its conduits and place its telephone wires underground in the streets, roads, public places, &c., in the city of Montreal for the purpose of its business and of its act of incorporation, and that it conformed to all that was required before the exercise of its rights and the execution of its said works.

"Considering that it is proved that defendant made efforts to deprive the plaintiff of its rights, and that, in fact, it interrupted and prevented plaintiff from carrying out its works and paralyzed its action in the exercise of said rights and powers, and this by force and violence.

"Considering that plaintiff established its right to a writ of

injunction in the particular case, and that the defendants have not justified the position taken by it, in its defence.

"Maintains the present writ of injunction and conjoins in consequence the defendant and said P. W. St. George to immediately cease to intervene in plaintiff's work and forbids them or their representatives to take up or alter in any manner the works commenced by plaintiff in said streets or places above mentioned and indicated, and to interrupt the works to be done in the said places and streets in question designated and indicated in the said request drawn up with the object of placing its wires according to its rights under terms of charter of said plaintiff. Costs of present writ of injunction and of contestation, distracts to Bethune & Bethune, advocates of said plaintiff, the whole subject to disposition and penalties provided by law in such matters."

TRADE NOTES.

The Montreal Street Railway Company have placed an order with the Canadian General Electric Company for 60 additional motors of their C. G. E. 1000 type.

The Canadian General Electric Co. are building two 600 horse power direct current railway generators, to be direct connected to synchronous motors in the Quebec sub-station of the Montmorency Company. They will deliver current at standard railway pressure for the new Quebec District Railway Company's system, the power to drive the synchronous motors being generated at Montmorency Falls.

The W. A. Johnson Electric Co'y, 34 York St., Toronto, have secured the contract for the electric generators and engines for the new Foresters' Temple Building, Bay St., Toronto. This is one of the largest office buildings in Canada, being nine storeys high, and the construction throughout is most modern. The electric plant consists of 3 direct current 50 kilowatt 125 volt generators, "Walker" type. These will be direct connected to 3 Ideal automatic engines, made by the Goldie & McCulloch Co. The Temple Building is the first large office building in Ontario to put in its own electric plant. This contract was awarded after keen competition.

The Canadian General Electric Company have closed a contract with Mr. Louis Simpson, general manager of the Montreal Cotton Co.'s mills at Valleyfield, for a second 450 kilowatt three-phase generator to be used in furnishing power to drive alternating motors throughout the mills. This will make the Valleyfield power house the largest for the supply of power by alternating currents up to the present in operation in Canada, the total capacity of the two three-phase generators being 1200 horse power, and of the induction motors in use about 1000 horse power.

WAGNER TRANSFORMERS TRIUMPHANT.

On September 15 the Lachine Rapids Hydraulic & Land Company of Montreal submitted specifications for transformers to the prominent manufacturers of electrical transformers both in the United States and abroad.

Its electrical engineer is Cary T. Hutchinson, and the principal points of the specifications were that at the maximum load the 30-kilowatt transformer should have an efficiency of 97 per cent.; not less than 96 per cent. from half to quarter load; not less than 80 per cent. at one-tenth load; total drop at full load, 2 per cent.; the insulation to be guaranteed to withstand successfully a test of 25,000 volts alternating current, continued as long as desired and repeated at arbitrary intervals. The tests required to ascertain the efficiency of the transformers were to be made in the factory of the maker, under the supervision of Mr. Hutchinson. The Wagner Company not only tendered a bid on these specifications as submitted by the Lachine Rapids people, but furnished in addition specifications of a more efficient transformer, showing that at one-tenth load an efficiency of 92 per cent. would be guaranteed, 12 per cent. better as compared with 80 per cent.; and at 100 per cent. load, 97.6-10 per cent.; while at $1\frac{1}{4}$ and $\frac{3}{4}$ load an efficiency of 97.5-10 per cent. was guaranteed, with a regulation of $1\frac{3}{4}$ per cent. As the amount of the order was upward of 900 kilowatt capacity, the \$10,000 contract secured by the Wagner Company is also taken to show that upon equal specifications its transformers are the cheapest. The company guarantees "the sufficiency and proper working of the said transformers for a period of two years from the erection thereof, and to repair any damage thereto or defects therein save and except damage resulting from lightning and mechanical injury, and in the event of any of the said transformers being found defective during the said term, the said contractors will replace the same with others of the quality, size and efficiency hereinbefore stipulated."—Electricity, N. Y.

The above contract also covered all future extensions required by the Lachine Co'y, involving about 9,000 K. W.

This sale was made by Mr. W. A. Johnson, of the W. A. Johnson Electric Co., Toronto, Canadian representatives for Wagner transformers. Many of these transformers are already in use in other Canadian cities.

QUESTIONS AND ANSWERS.

JAMES MCPHERSON writes : " Could any of my brother engineers tell me if an injector will force cold water just up eight feet, then along 18 feet, then through a Wain-right circular coil heater and back again same way to boiler front? Our heater is at the back of the boiler. We have no feed pump so the heater is useless, and would like very much to be able to use it. Over in the foundry we have a small Blake pump which gets its water under a varying head from 20 to 40 lbs. ; it has to pump it a distance of 80 feet and then up about 90 feet into big fire tanks. The pump works quite freely but pounds awfully bad in the water end. What should I do to overcome this? "

ALFRED THORNTON, Quebec, writes : " My elevator compression tanks give me lots of trouble, or rather the losing of water from the tanks. There are no leaks in the tanks as a matter of course, and all glands, etc., on the elevator gearing are as they should be. Yet I can never get as much water kept in the glass as ought to be. If I choke off the air from the pump then you should hear her knock. I have heard some elevator pumps scrunt and scrap a very great deal in the steam cylinder when they were going dead slow, and although it doesn't occur in mine, yet I would like to be able to give a pointer to those who suffer. "

MOONLIGHT SCHEDULE FOR FEBRUARY.

Day of Month.	Light.	Extinguish.	No. of Hours.
	H.M.	H.M.	H.M.
1.....	P. M. 5.40	A. M. 6.10	12.30
2.....	" 6.00	" 6.10	12.10
3.....	" 6.30	" 6.10	11.40
4.....	" 7.20	" 6.10	10.50
5.....	" 8.20	" 6.10	9.50
6.....	" 9.30	" 6.10	8.40
7.....	" 10.30	" 6.10	7.40
8.....	" 11.30	" 6.10	6.40
9.....	"	" 6.00 }	5.10
10.....	A.M. 12.50	 }	4.00
11.....	" 2.00	" 6.00	3.10
12.....	" 2.50	" 6.00	2.20
13.....	" 3.40	" 6.00	.....
14.....	No light.	No light.	.....
15.....	No light.	No light.	.....
16.....	No light.	No light.	.....
17.....	No light.	No light.	.....
18.....	P. M. 6.00	P. M. 9.10	3.10
19.....	" 6.00	" 9.10	3.10
20.....	" 6.00	" 10.30	4.30
21.....	" 6.00	" 11.40	5.40
22.....	" 6.00	A. M. 12.50	6.50
23.....	" 6.00	" 2.10	8.10
24.....	" 6.00	" 3.20	9.20
25.....	" 6.10	" 4.20	10.10
26.....	" 6.10	" 5.20	11.10
27.....	" 6.10	" 5.20	11.10
28.....	" 6.10	" 5.40	11.30
.....			
.....			
.....			
Total,			179.30

Four-fifths of the steam engines now working in the world have been constructed during the last 25 years. France has 79,590 stationary and locomotive boilers, 1,850 boat boilers, and 7,000 locomotives. Germany has 59,000 land boilers, 1,700 ship boilers, and 10,000 locomotives. Austria has 12,000 boilers and 2,800 locomotives. The working steam engines of the United States represent 7,500,000 horse power; of England, 7,000,000 horse power; Germany, 4,500,000 horse power; France, 3,000,000 horse power; Austria, 1,500,000 horse power. This estimate does not include locomotives, whose number in the world is 105,000, representing a total of 3,000,000 horse power. The world's steam engines, however, aggregate more than 26,000,000 horse power, equivalent approximately to the work of 1,000,000,000 men,

SPARKS.

The city of Fredericton, N. B., will put in a fire alarm system, to cost \$5,000.

A local company at Parrsboro, N. S., intends putting in an electric light plant in the spring.

The city of Hamilton received \$12,704.66 from street railway receipts last year, against \$13,249.19 in 1895.

The mayor of Port Arthur, Ont., urges that the street railway power plant be sufficiently increased to light the town with electricity.

In the whole of Great Britain there are but sixty-seven miles of electric street railway, or thirteen miles less than in the city of Toronto.

E. P. Plante and E. Pratte have registered a partnership in Montreal to carry on business as electricians under the style of Plante & Pratte.

The Sandusky Electric Railway Company, of Sandusky, Ohio, has gone into the hands of a receiver. The indebtedness of the company is \$120,000.

It is reported that certain Quebec gentlemen are considering the utilization of the water powers in the vicinity of Parry Sound, Ont., for supplying power, light, etc.

The Westinghouse Manufacturing Co., of Hamilton, has been incorporated, with a capital of \$500,000. Hon. J. M. Gibson and Dr. Archibald Malloch are interested in the company.

The Cataract Power Company is said to have closed contracts for supplying electric power to the largest users in Hamilton for a term of five years. The plant is expected to be in operation by June next.

Mr. W. K. Knowles, a director of the Callender Telephone Exchange Company, of Brantford, Ont., has written to the City Council of Toronto requesting permission to tender for the telephone franchise.

At the headquarters of the Great Northwestern Telegraph Co., in Toronto, there are employed 90 operators, 50 messengers and 6 linemen. The Company have 35 city branch offices and 1,800 offices in connection with their entire system.

On the ground that various requirements of the Municipal Act had not been complied with the Courts recently quashed a by-law of the town of Listowel, Ont., providing for the creation of a debt for the purpose of lighting the town by electricity.

The Valley Telephone Co., of Annapolis, N. S., intend making extensions in their circuit next spring. A line will be run from Annapolis to Bridgetown, via Round Hill, and from Clementsport to Clementsvalle, and thence to Bear River.

The Auburn Power Company, of Peterboro, Ont., has been incorporated by the Ontario Government, the capital stock being \$99,000. The promoters are James Kendry, John Carnegie, R. M. Dennistown, W. H. Meldrum and Margaret Meldrum.

Incorporation is asked by the London Electric Motor Co., to manufacture electrical machinery. The head-office is at London, Ont., the promoters being S. R. Break, W. H. Wortman, C. E. A. Carr, S. Potter, E.E., A. Gorman, T. J. Cahill and W. Barton. Capital, \$45,000.

A demonstration of the application of X rays to surgery was recently given by Mr. O. Higman, head of the Electric Inspection Department at Ottawa, in the presence of a number of the physicians of that city. A Tesla high frequency and high potential coil was used to excite the Crookes tube.

A company at Rossland, in which Mr. W. S. Norman is interested, are bringing electric power from a branch of the Columbia river, 12 miles away. They will generate 1,500 horse power, or sufficient for the 21 machinery plants at the camp, besides supplying light and power to Trail and Rossland.

The contracts for the equipment of the electric railway at Quebec have been given. The cars will be built by the Ottawa Car Company, the trucks by the Taylor Electric Truck Co., of Troy, N. Y., and the electrical apparatus by Ahearn & Soper, of Ottawa. The cars will be 18 feet long and will be supplied with 12 incandescent lights.

The Hull Electric Co. and the Ottawa Electric Light Company have begun cutting prices. The former company reduced their figures for lighting from 15½ to 12½ cents a light per week. Now the Ottawa Electric Light Company have done the same. The competition is so keen between the companies that a further reduction may take place, and the consumers are rejoicing.

SPARKS.

Stouffville, Ont., is moving in the direction of securing electric lights.

Steps will probably be taken by the ratepayers of Dundas, Ont., to secure electric street lighting.

The Citizens' Telephone and Electric Company, of Rat Portage, Ont., propose putting in an electric plant for supplying power.

The town of Millbrook, Ont., is reported to have dispensed with its electric light service, owing to the poor light supplied.

Mr. John Moodie, of Bell's Corners, has made a proposition to the County of Carleton to construct an electric railway from Richmond to Bell's Corners, and to supply light and power. A bonus of \$10,000 is asked.

James Halliday, electrician for the Kingston street railway, has invented a new fender for street cars. It consists of a strong wire netting woven across a framework of one and a half inch iron tubing. A canvas background protects the draw-bar and bumper.

Application has been made to the Ontario Legislature for letters patent incorporating the Seine River, Foley and Fort Frances Telegraph and Telephone Co. The objects of the company are stated to be the building of telegraph and telephone lines through the Seine River gold fields to Fort Frances.

In the United States there is invested in motors \$500,000,000, in electric mining apparatus \$100,000,000, in electric railways \$700,000,000, in electric lighting \$500,000,000, in the electric elevator industry \$15,000,000. This is exclusive of the value of establishments that manufacture the machinery and apparatus.

A meeting of the provisional board of directors of the Huron and Ontario Electric Railway was held in Toronto last month, at which the promoters in New York presented a request for further details regarding water powers and grades. When these are furnished it is thought the contract for the construction of the road will be signed.

The officers of the Canadian Marine Engineers' Association for the ensuing year are as follows:—Hon. president, O. P. St. John; president, E. J. O'Dell; first vice-president, Frank Limpert; secretary, S. A. Mills; treasurer, D. L. Foley; inside guard, J. R. Young; auditors, F. E. Smith and J. H. Ellis; councillors, R. McLaren, W. B. Stevens, James Currie, R. Childs and E. Abbey.

A meeting of the Board of Directors of the Packard Electric Company was held at St. Catharines, Ont., on January 23rd, at which the following officers were elected: President, J. W. Packard; Vice-President and Treasurer, W. D. Packard; Secretary and Manager, E. E. Carey; Directors, J. W. Packard, W. D. Packard, E. E. Carey, G. A. Powell, G. B. Morley, P. J. Crowley.

The report of the directors of the Ottawa Electric Railway Company is a most encouraging one. The number of passengers carried last year was 5,583,235, the gross receipts were \$212,105, and the net profits \$67,745. Four quarterly dividends of two per cent. each were declared. It is stated that the mileage of the company is greater than that of any other city in Canada according to population.

The following, relating to the street car fender, appears in a 'Guelph exchange': "Thursday afternoon a lady on Woolwich street, who is going to leave the city for a few days, came out and, stopping the car, asked the conductor if he would please get the motorman to help her husband out with a trunk. On being told the company would not carry trunks, she replied 'Oh my, how stupid, I thought that was a patent baggage carrier you had hitched on.'"

A company of eastern capitalists has been formed at Rossland, B. C., to build an electric railway between that point and Spokane, a distance of 160 miles. Application is now being made to the Washington Legislature for a charter to build that part of the projected road south of the boundary line. The power for the road will be obtained from the falls of the Kettle river, which is 110 miles from Spokane. It is unlikely that the Rossland branch will be constructed this year.

The Grand Trunk Railway Company are said to be considering the lighting of their cars by electricity. In England, one or two of the railways light their cars by electricity in a novel way. The system consists in providing each car with a small dynamo placed beneath it and worked directly by a belt passing over the axle.

When in motion the car supplies sufficient power to drive the dynamo and at the same time to store electric energy in an accumulator ready to supply light when the train is standing.

In obedience to the decision of the Judicial Committee of the Privy Council in the matter of duty on street rails, an order-in-Council has been passed sanctioning the refunding of the duties paid on steel rails for street railways from 1887 to March 27, 1894, when the present law came into force. The whole amount of claims against the Customs Department under this head is some \$138,000, of which \$50,000 was by the judgment awarded the Toronto Street Railway, and \$50,000 is claimed by Messrs. Ross & Mackenzie for the Montreal Street Railway. The customs officials at Ottawa are engaged in investigating the claims.

The Canadian Niagara Power Company held a meeting at Niagara Falls, Ont., on the 13th ultimo. There were present Colonel Albert D. Shaw, of Toronto, president of the company; Mr. Francis Lynde Stetson, of New York, vice-president; Mr. William B. Rankine, of New York, secretary and treasurer; and Mr. C. J. Holman, of Toronto, one of the directors. The old officers were re-elected. The company desires an extension of its lease for four years, in regard to developing the power, and had an important conference with Mr. John W. Langmuir, president of the Park Commission, in regard to this matter.

The Owen Sound Electric Illuminating & Mfg. Co. have just added to the plant of their power house on river Sydenham, $2\frac{1}{2}$ miles from the town, a 50 k. w. S. K. C. generator, and are now busy equipping several business houses with incandescent and arc lights from this dynamo. It is also intended in the near future to run a day circuit for power. The pressure on the primary mains is 2,000 volts, and on the secondary mains 104 volts. The lamps are $3\frac{1}{4}$ watts to the candle power. The station is now equipped with two Royal 40-light arc dynamos (using a current of 9.6 amperes), and the above-named 50 k. w. S. K. C. generator. The two arc machines have been running for about 11 years, during which time they have had no trouble whatever with them.

An English scientific expert has reported upon the distribution of telephones in different countries in Europe, on which is based an article in the Literary Digest, N. Y. It is surprising to find the system most extended in Norway, Luxemburg, Switzerland and Denmark. Norway has a telephone to every 144 inhabitants, while Great Britain has only one to every 636, France one to 1,432, Austria one to 1,640, Italy one to 2,530, and in Russia there is only one instrument for every 13,102 of inhabitants. In Luxemburg the price of a telephone is \$16, which covers everything, the consequence of this cheapness being that the whole of the Grand Duchy has a telephone service. In other parts of Europe a system has been established for bringing the villages into a circuit of telephones, a development along the lines of which there will ere long be great advances made in Canada.

The Sherbrooke Gas and Water Co., of Sherbrooke, Que., are remodelling their entire electric lighting plant and water power. They have purchased from the Royal Electric Co. one 180 k. w. and one 60 k. w. "S. K. C." generators. This, in addition to the 60 k. w. "S. K. C." generator purchased from the same company about a year ago, will make up the electric equipment for both light and power. It is their intention to use the smaller units for lighting purposes during the hours of light load, and the large machine for power purposes only, during the day time; but during the lap hours, that is, from five to seven o'clock in the afternoon, when the lights and power are both on, the three machines will be working together on the same circuit. It is also their intention to change their entire transformer equipment, replacing them with those of a higher efficiency.

A despatch from London, Eng., says: A new electric locomotive of large dimensions, calculated to draw trains of double the weight of those attached to ordinary engines at a rate of sixty-two miles an hour, has been tried with success on the Western Railroad of France line. The first experiments of this kind were made in 1893 between Havre and Beuzeville with an electric locomotive which behaved well throughout the trial trip. Owing to the success of this machine, the company's engineers constructed two larger locomotives, and it is one of these which has just been tested. It is 57 feet long and 1,350 horse power. In spite of their size, they wear out the rails less than ordinary locomotives, as the weight is distributed on eight axles instead of four or five. They are safer than the others, owing to their elastic character, which enables them to make curves with security at full speed. Great things are, in fact, expected from these contrivances, which, when perfected, are expected to do 100 to 115 miles an hour.

ELECTRIC RAILWAY DEPARTMENT.

MR. F. L. WANKLYN.

WITH considerable enterprise Toronto capitalists have, during the past year, taken definite action towards securing control of the street railway franchises of several cities in England, with the object, evidently, of electrifying the systems. Foremost among these



MR. F. L. WANKLYN.

capitalists has been Mr. Wm. Mackenzie, president of the Toronto Street Railway, who has made several trips across the Atlantic in that connection. So much of his time has been thus devoted that it became necessary to relieve him of some of his duties in Canada, and the appointment of a manager for the Toronto Street Railway was decided upon by the company. The person to receive this appointment is Mr. Frederick L. Wanklyn, of Montreal, whose portrait we present.

The new manager is an engineer of large experience, and has an intimate knowledge of street railways, having spent several years supervising the construction of such in Lombardy. He was born in Buenos Ayres not quite 38 years ago, and educated at Marlborough College, England. He served a regular pupilage under the late Charles Sacre, M. Inst. C. E., Chief Engineer of the Manchester, Sheffield and Lincolnshire Railway, at the Gorton Works, Manchester. His first appointment was that of resident engineer of the Tramways and General Works Company on their lines in Lombardy, Italy. Subsequently he became general manager and engineer of the Lombardy Road Railways Company, with headquarters at Milan.

Upon coming to Canada he was appointed to the position of assistant mechanical superintendent of the Grand Trunk Railway, under Mr. Herbert Wallis, M. Inst. C. E., and subsequently was given charge of the extensive works of the company at Point St. Charles, in Montreal. Since the change in the administration he has filled the position of master mechanic. During the conversion of the Montreal street railway, and the erection of the new power-house, he acted as consulting mechanical engineer to the company. He is a member of the Canadian Society of Civil Engineers and an associate member of the Institute of Civil Engineers, England.

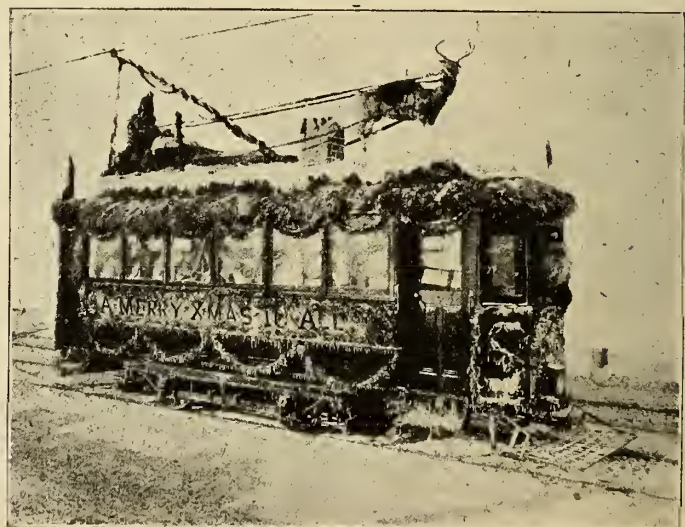
Before leaving Montreal, the employees of the Grand

Trunk Railway shops presented Mr. Wanklyn with a handsome illuminated address, expressive of the good feeling which existed between them. He was also presented with a gold-headed cane by the employees of the rolling mills.

Those who are best acquainted with the new manager consider the step a wise one on the part of the company, and we have no doubt that proof of his ability will be forthcoming in still further improvements to an already prosperous road. Mr. Wanklyn has been elected as a member of the Board of Directors.

SANTA CLAUS ON A TROLLEY CAR.

An illustration appears herewith of the trolley car from which Santa Claus gladdened the hearts of the children of Ottawa by the distribution of Christmas fruit and candies, which was referred to in our last issue. Mr. Warren Y. Soper, of the firm of Ahearn & Soper, caused letters to appear in the daily papers, signed "Santa Claus," which stated that he would visit Ottawa on the day before Christmas and make a day-light tour through the streets on top of an electric car. A time table was furnished indicating at what time he would reach certain points, and before that time the streets were thronged with men, women and children. When the car appeared it was covered with snow and ice, indicating its recent arrival from the far north. On the front vestibule were the figures "1896," and on the rear "1897." The interior of the car was filled with toys of every description, and Santa Claus was on top driving his reindeer, with a basket of toys on his back. The motorman and conductor were costumed as Icelanders, and an Eskimo played on a cornet during the trip. As the car proceeded, Santa Claus distributed the oranges, etc., assisted by several persons inside the car.



A CHRISTMAS CAR.

Some four thousand oranges were placed at the disposal of the children, the scrambling for which created no little amusement.

IMPROVING WITH EVERY NUMBER.

Mr. E. F. G. Fletcher, Gravenhurst, Ont., in remitting his subscription to the ELECTRICAL NEWS, writes: "Your paper is improving with every number, and I consider it far ahead of any other electrical paper I take."

TORONTO STREET RAILWAY.

THE annual meeting of the shareholders of the Toronto Street Railway Company was held on the 20th of January last. The report of the directors showed the net profits of the year to be \$282,086.47. From these profits two dividends at the rate of $1\frac{3}{4}$ per cent. each were declared, amounting to \$210,000, leaving, after the deduction of an allowance for pavement charges amounting to \$60,000, the sum of \$12,026.47 to be carried forward. The gross earnings for the year ending December 31, 1896, showed a slight increase over the previous year. During the past year the operating expenses exceeded the previous year by \$17,845.55. This increase occurred almost altogether in electrical equipments, a large proportion of which was due to the accumulation of water upon the tracks of the company during the spring weather. By the decision of the Privy Council the Government refunded the company the amounts collected as duty on the rails used in the construction of its system. This amount (\$56,000) was carried to the credit of capital account. The president, having found that his business in England prevented his giving the company's affairs sufficient attention, determined to appoint a manager, and the board, after careful consideration, have selected F. L. Wanklyn, of Montreal.

The company built in its own shops during the year, twenty open motor cars. The following statement of operating expenses was presented :

	1896.	1895.
Gross earnings	\$997,273.28	\$992,800.80
Operating expenses	507,760.31	489,814.76
Net earnings	\$489,512.97	\$502,886.04
Passengers carried ...	23,537,911	23,355,228
Transfers	7,354,895	7,257,572

Percentage of operating expenses to earnings, in 1896, 50.9 ; in 1895, 49.3.

The assets were reported to be \$9,780,914, made up as follows : Equipment and real estate, including suburban lines, \$9,536,912 ; stores in hand, \$23,404 ; accounts receivable, \$34,359 ; cash in bank, \$186,237. After the adoption of the report the meeting adjourned, and at a special meeting of the shareholders a by-law was passed authorizing the directors to increase their number two new directors. The new directors were not elected, however, as due notice has to be given before the election. Mr. F. L. Wanklyn, the new manager, will likely be elected to the Board of Directors.

The old Board was re-elected as follows :—William Mackenzie, J. Ross, Hon. Geo. A. Cox, W. D. Matthews and James Gunn. At a subsequent meeting of the directors Mr. Mackenzie was elected president, and Mr. Ross vice-president.

HAMILTON, GRIMSBY AND BEAMSVILLE RAILWAY.

THE annual meeting of the Hamilton, Grimsby and Beamsville Railway was held at Hamilton on the 25th of January, the president, Mr. T. W. Lester, occupying the chair. The report for the year showed the total receipts were \$35,277.91, and the expenditure charged to current account \$24,121.87, leaving a net revenue of \$11,156.04. This is equal to about $9\frac{3}{4}$ per cent. on the capital stock. It was pointed out that a considerable percentage of the amount nominally expended for repairs was really for new construction, or to make good the alleged faulty work in the original construction. The president reported that the Beamsville

extension had cost about \$40,000. The directors recommended that a dividend at the rate of 7 per cent. be paid upon the stock of the company. This would take about \$8,000, leaving \$3,155 to be carried to the reserve—in other words, to be applied to the reduction of the floating liabilities of the company. A comparative statement of the receipts for the years 1895 and 1896 was as follows : 1895, \$34,084.99 ; 1896, \$35,277.91. The number of passengers carried last year was 243,394, as compared with 236,656 the previous year, the average each day being 666 in 1896 and 648 in 1895. The passenger fares in 1896 amounted to \$29,695.35, as against \$29,525.71 in 1895. The total miles travelled last year were 196,006, a slight increase over the previous year.

There was a strong fight for office between the Myles and the Lester factions, which resulted in the overthrow of the latter. The following were the directors elected :—Messrs. C. J. Myles, A. H. Myles, W. J. Harris, R. Ramsay, R. S. Martin, L. Bauer and John Gage. At a subsequent meeting C. J. Myles was elected president, Wm. Harris, vice-president, R. S. Martin, treasurer, A. J. Nelles, manager and secretary, and H. J. Brown, electrician. Mr. Adam Rutherford, the former secretary, has been asked to resign.

LONDON STREET RAILWAY.

At the annual meeting of the London Street Railway Company, held on January 13th, the directors present were :—H. A. Everett, president ; E. W. Moore, vice-president ; C. W. Wason, of Cleveland ; H. S. Holt, of Montreal, and Thomas H. Smallman, of London. Mr. C. E. A. Carr, the manager, acted as secretary.

The reports of the past year's operations were presented, and were considered highly satisfactory. Over 2,500,000 passengers were carried in the twelve months, and operations were conducted for $57\frac{1}{2}$ per cent. of the gross receipts.

Mr. Charles Currie resigned his position as secretary-treasurer, owing to his removal to Lima, Ohio, where he assumes the management of the Everett line. The old board was re-elected, and Manager Carr was appointed to act as secretary-treasurer and manager.

STREET RAILWAY ACCIDENTS.

THE Court of Appeals of Maryland held, in the case of The Baltimore Traction Company vs. Helms, that where one deliberately walks out from behind a street car from which he has alighted, and attempts to cross a public street without using his powers of observation, and is injured by an approaching car, which injury could have been avoided by the use of the most ordinary care, he will not be allowed to recover. The court said it did not intend to lay down the same rule of conduct as always applicable to the crossing of tracks of steam and street railways, and added : "The legal duties and correlative rights in the two cases are not the same, and what might be negligence in the one case would in the other, under some circumstances, be held to be but the exercise of a legal right. It is not necessary in this case to formulate any general rule as to the degree of care required of persons crossing highways in cities, for, as we have seen, the plaintiff failed to exercise any care whatever, and seeks to avoid the legal effect of his own misconduct by relying upon the negligence of the defendant."

PERSONAL.

W. J. Hands, recently engineer of the Electric Light and Water Co., Gananoque, Ont., has been appointed engineer at Upper Canada College, Deer Park, Toronto.

Mr. Ross McKenzie, formerly of the Niagara Falls Park and River Railway, will, it is said, succeed Mr. George Campbell as manager of the Winnipeg road.

Messrs. A. M. Wickens and J. J. Main have been elected on the Technical School Board of Toronto to represent the Canadian Association of Stationary Engineers.

Mr. A. J. Durley has received the appointment of assistant professor of Mechanical Engineering in the Faculty of Applied Science at McGill University, Montreal.

Mr. James Ross, Vice-President of the Montreal Street Railway, accompanied by Mr. Grenville Cunningham, Managing Director of the company, took their departure from New York a fortnight ago en route to England on a business trip of some weeks.

The many friends of Mr. A. E. Edkins, Registrar of the Ontario Association of Stationary Engineers, will be pleased to learn that he is rapidly recovering from his recent severe illness, and that his entire convalescence is now only a matter of time. Mr. Ed-

kins literally passed through the valley of the shadow of death, having been at one time considered by his physicians to be entirely beyond hope of recovery. A kind of Providence, assisted by a splendid physical constitution, have, however, pulled him through the ordeal, and we trust that for many years to come he may be spared to his family and friends.

PUBLICATIONS.

A very handsome calendar has been issued by the Boiler Inspection and Insurance Co. It is said to be the first issued in Ontario from steel plates engraved by Canadian artists.

The Wm. Hamilton Mfg. Co., of Peterboro, Ont., have sent us copies of their new catalogues containing illustrations and descriptions of their "Payne" automatic Corliss engine, steam boilers and other machinery. Included in the contents of these catalogues are several valuable tables of calculations relating to the operation of steam engines. A copy of these catalogues will be sent to any address on application.

Mr. Geo. W. Epps, in remitting his subscription, remarks that the ELECTRICAL NEWS is thoroughly up-to-date in every respect.

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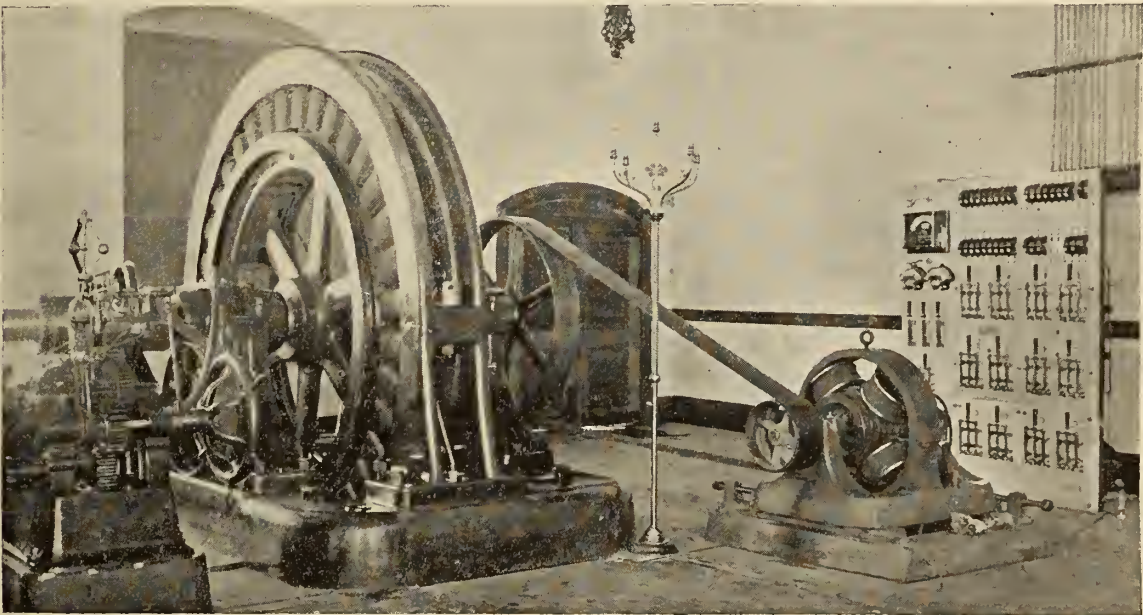
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SPARKS.

The new plant so far ordered by the Toronto Electric Light Company to replace that destroyed in their recent fire consists of 8 Brush arc machines of the latest type, having a capacity of 125 2,000 c.p. lamps each.

The recent fire at the power house of the Toronto Electric Light Co. was the occasion of an exceedingly prompt piece of shipping work from the factories of the Canadian General Electric Co. at Peterboro'. A telephone message from Mr. J. J. Wright reached Mr. Stephens, general superintendent of the works, at 7.45 in the morning, and at 8.30 a car-load of arc apparatus, including a 125-light Brush machine, was on its way to Toronto, where it arrived in time to be put in service the same night.

Application is being made to the Ontario Legislature by Alexander H. Edwards, of Carleton Place; John B. Riley, of Plattsburg, N. Y., United States Consul General at Ottawa; Thomas Henry, of Montreal, and James Fowler, of Arnprior, for an Act to incorporate the Lanark County Electric Railway Company, with power to construct a line of railway from the town of Perth to the village of Lanark, and to extend the same to Olivers Ferry and Smiths Falls on the south, and to Almonte and Carleton Place on the north.

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See article page 25.

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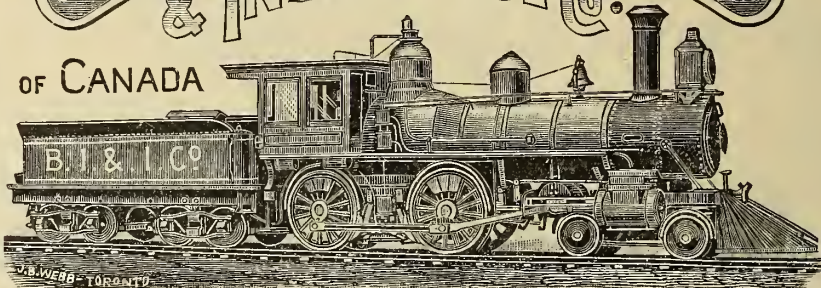


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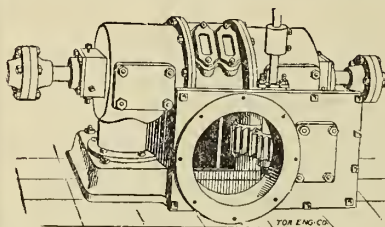


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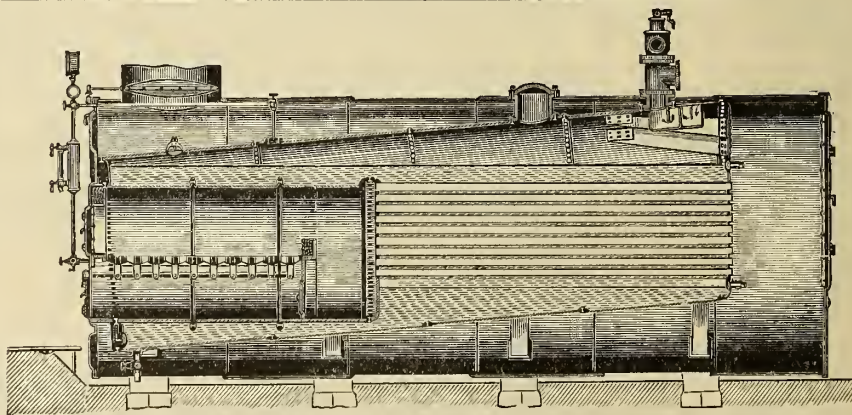
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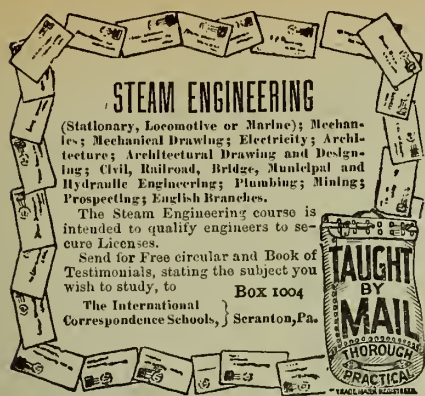
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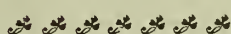
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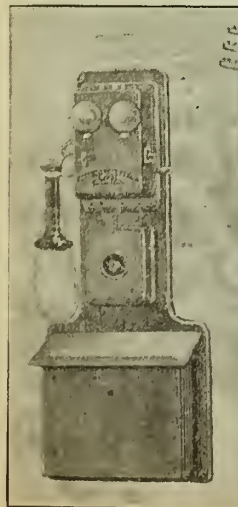
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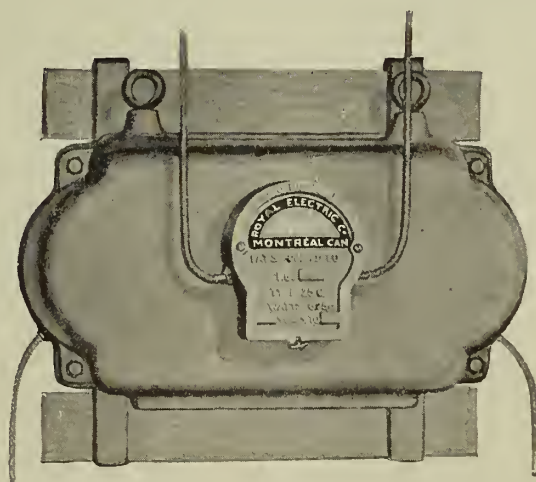
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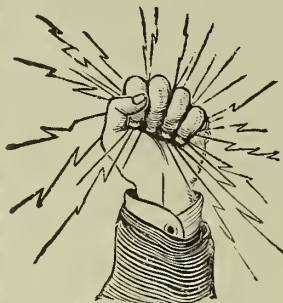
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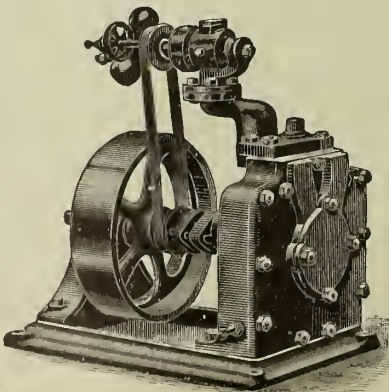
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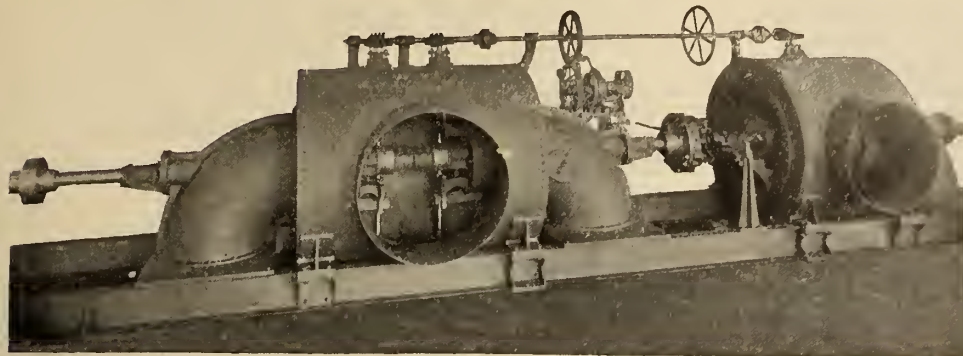
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....TO....

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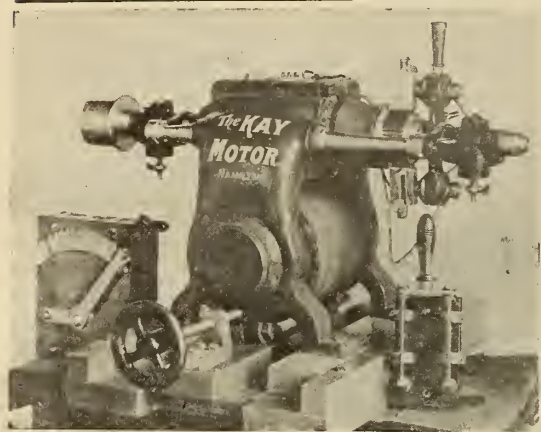
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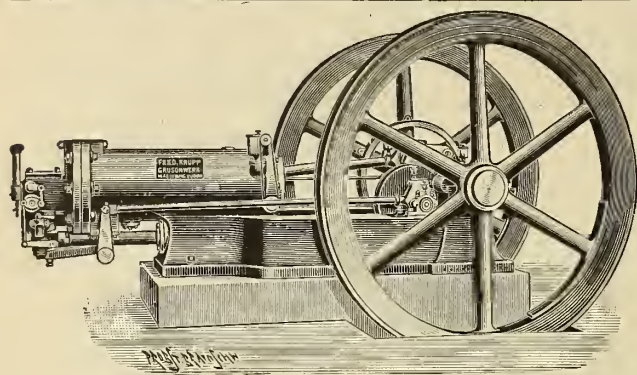
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CANADIAN
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STEAM ENGINEERING JOURNAL.

VOL. VII.

MARCH, 1897

No. 3.

MR. W. H. BROWNE.

A PERUSAL of the somewhat lengthy address, printed elsewhere in this number, delivered on the occasion of a visit of inspection to the works of the Royal Electric Company, Montreal, will serve in a measure as an introduction to the manager, Mr. W. H. Browne, a capital portrait of whom appears on this page. Scarcely more than two years has elapsed since his acceptance of the position of head of one of the largest electrical manufacturing concerns in Canada, yet through his energy and ability the company have been compelled to greatly enlarge their plant, and to-day they possess a modern factory in every respect, with a plant valued at \$2,500,000, and employing 500 workmen.

Mr. Browne was born under the American flag in the year 1849, his birth-place being Troy, N. Y. When only seventeen years of age he was attracted to the city of New York, where he engaged in the foundry and general hardware manufacturing business. The mechanical as well as business experience thus obtained formed the foundation of his future success, as, in addition to being afforded the opportunity of perceiving the possibilities of the electrical field, he was brought in contact with some of the leaders of commercial and industrial enterprise in the American metropolis.

Besides investing in other electrical enterprises, Mr. Browne became interested in and was one of the organizers of the Richmond, Va., electric railway, which was the first electric railway in the United States, and was commenced in the year 1888. He continued as manager of this road and its lighting plant until 1891, but in addition received the appointment in 1888 of manager of the United Electric Light and Power Company, perhaps the largest concern of the kind existing at that time, which afterwards absorbed the United

States Illuminating Company and the Brush Illuminating Company. Mr. Browne has occupied his present position since January, 1895, and during the past two years the company have met with marked success.

THE BELL TELEPHONE COMPANY.

THE seventeenth annual meeting of the shareholders of the Bell Telephone Company was held in Montreal

last week. The annual report presented showed that 653 subscribers had been added during the year, the total number of sets of instruments earning rental being 29,462. The company now owns and operates 341 exchanges and 275 agencies.

There were 176 miles of poles and 1,013 miles of wire added to the long distance system in 1896; of these 11 pole miles and 236 wire miles are in the Ontario department, and 165 pole miles and 777 wire miles in the eastern department.

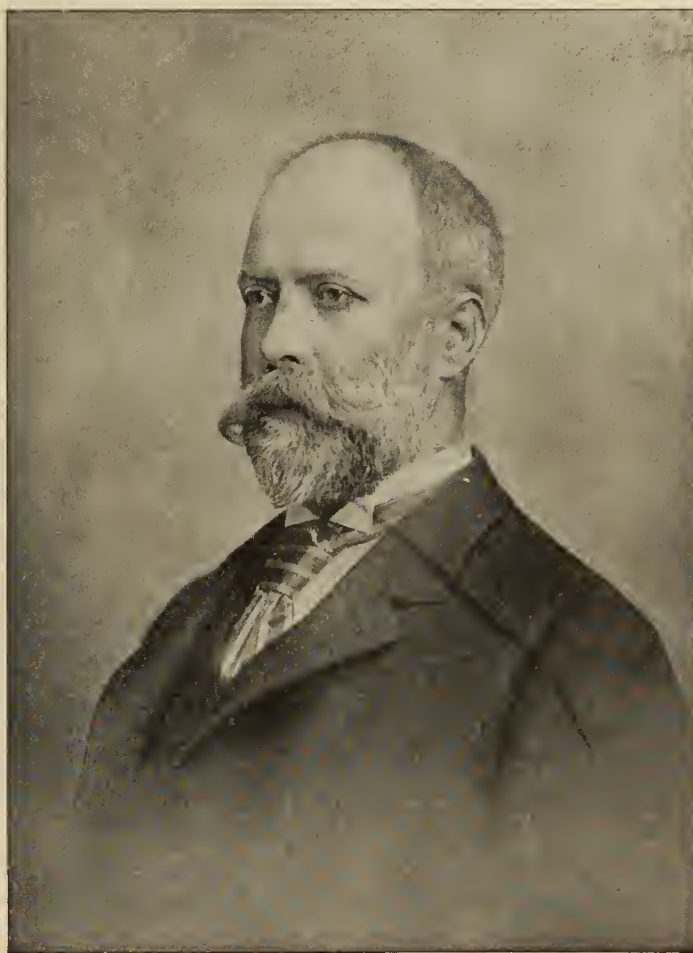
The long distance lines now owned and operated by the company comprise 15,864 miles of wire on 6,060 miles of poles. The new building in Montreal is nearly completed, and will be ready for occupancy in May. The new building in

Winnipeg was completed last November.

Mr. John Crawford expressed a doubt as to the advisability of extending the long distance service. He did not consider it as profitable as the short distance.

The annual report was adopted and the old board of directors unanimously re-elected, which terminated the proceedings.

E. S. Jenison, of Port Arthur, Ont., proposes to utilize the water power of the Ecarte Rapids and Kakabeka Falls, on the Kaministiquia river, for light and power purposes, and is seeking authority therefor from the Ontario government. Moss, Barwick & Franks are acting as solicitors.



MR. W. H. BROWNE, Manager Royal Electric Company.

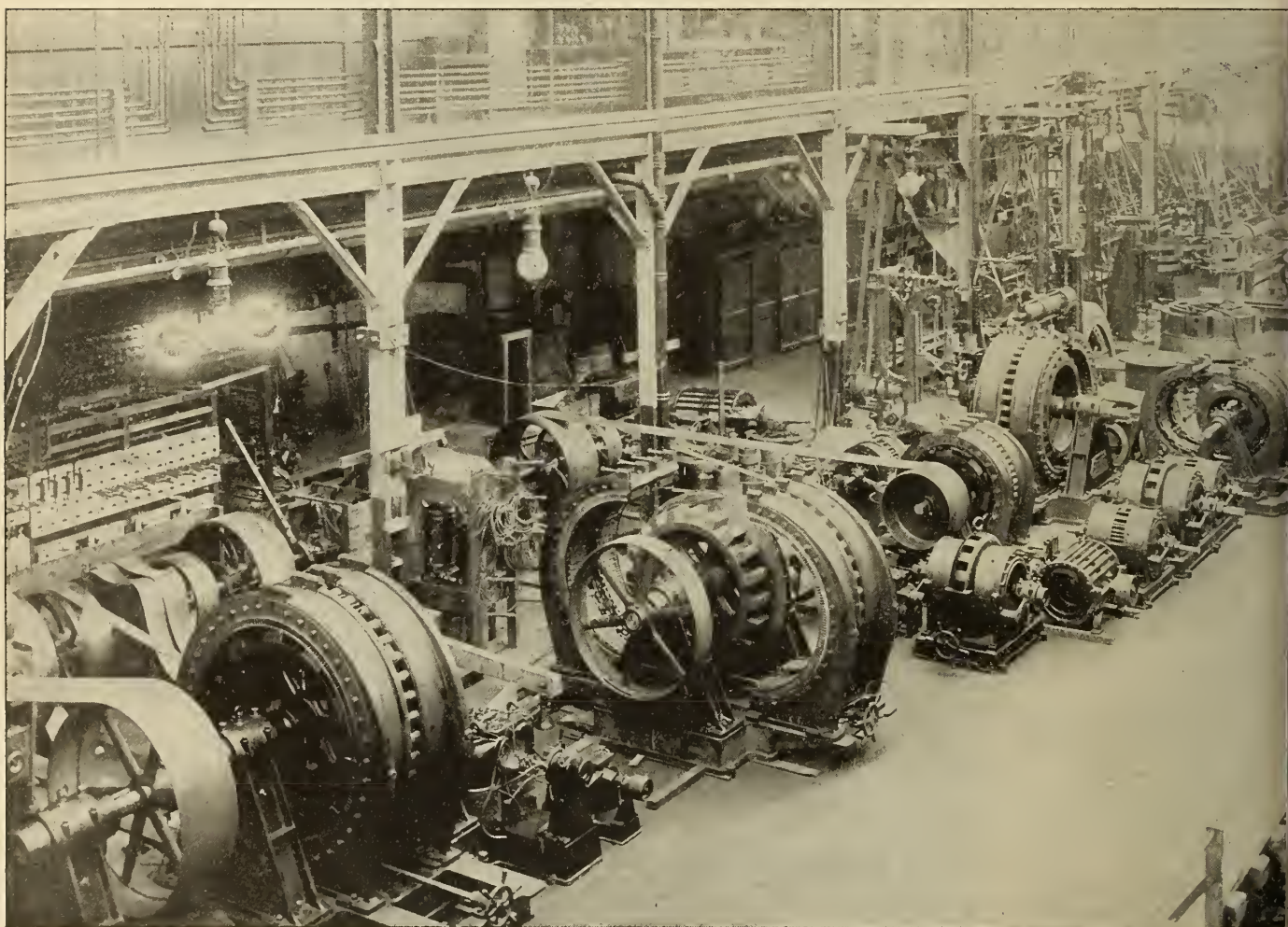
THE ROYAL ELECTRIC COMPANY.

IN response to the invitation of the above company, a large number of persons, comprising shareholders and men prominent in the various walks of life, gathered in Montreal on the 10th of February for the purpose of making an inspection of the company's generating station and manufactory. In point of arrangement and equipment this station and factory are claimed to be representative of the most modern practice, and therefore offer a valuable object lesson to the visitor.

The following persons connected with the electrical interests were present, in addition to a large number representing the various branches of commerce as well as the professions:

Mr. F. H. Badger, Manager Montmorency Electric

The works were gaily decorated with flags, and on the second floor of the generating station was spread a tempting luncheon. Here the visitors received a hearty welcome from the President of the company, the Hon. Senator Thibeaudeau, who in his concluding remarks introduced Mr. W. H. Browne, the general manager of the company. Mr. Browne spoke at some length, outlining in a very able and interesting manner the development of the company's enterprises from their earliest beginnings. Mr. Browne's remarks, printed in full below, will repay careful perusal, as showing the wonderful strides in the direction of development and improvement which electricity is making in the Dominion. Canada has not been content merely to keep abreast of the times, but is actually proving herself to be a



VIEW OF ROYAL ELECTRIC COMPANY'S FACTORY, MONTREAL, SHOWING APPARATUS RECENTLY COMPLETED.

Power Co., Quebec; Jules Bourbonniere, Manager Imperial Electric Co., Montreal; W. J. Camp; A. A. Dion, Superintendent Ottawa Electric Co., Ottawa; Ormond Higman, Chief of the Electric Light Inspection Department, Ottawa; W. Munderloh, of Messrs. Munderloh & Co., Montreal; L. B. McFarlane, Supt. Bell Telephone Co., Montreal; R. E. T. Pringle, Montreal; Fred. Thomson, of Messrs. F. Thomson & Co., Montreal; J. J. Wright, Manager Toronto Electric Light Co.; Prof. Carus Wilson, Electrical Department, McGill University, Montreal; Edward Carter, St. Johns Elec. Co., St. Johns, Que.; H. O. Fisk, Supt. Peterboro' Light and Power Co., Peterboro', Ont.; J. M. Fortier, Pres. Imperial Electric Light Co., Montreal; Jas. H. Howry, Packard Electric Co., St. Catharines, Ont.; J. A. Kammerer, General Sales Agent, Royal Electric Co., Toronto; E. A. Lacroix, North Shore Power Co., Three Rivers, Que.; W. S. Shaw, Shaw Electric Co., Montreal.

pioneer in electrical progress, both in relation to lighting and power. Mr. Browne spoke as follows:

GENTLEMEN,—To the citizens of Montreal the Royal Electric Company is well and chiefly known by the brilliant illumination which provides the security of daylight to the streets and parks of the city.

It is also known by the cheerful radiance of the numerous incandescent glow lamps, which makes pleasant and decorate so many residences and places of business.

As a manufacturer of electrical machinery and apparatus, it is, however, better known throughout the Dominion of Canada than in the city of Montreal.

It has been manifest on several occasions that many, even of those who are intimately acquainted with the company, have very little actual knowledge of the extent and character of the source of the illumination they enjoy and have a very inadequate conception of the enterprise represented by, or the establishment constituting the Royal Electric Company.

To those throughout the Dominion, who are users of electrical appliances, the company is well known as manufacturers of the best and most advanced type of such appliances, and in a general way as conducting the largest electric light and power plant in Canada, but the full extent of this feature of the business is not thoroughly comprehended even by those who purchase and use its manufactures.

The completion of recent improvements made in the generating station, and of the equipment of the new factory in full working

order, and at work in the manufacture of large apparatus, has, therefore, been deemed an appropriate occasion to bring to the personal knowledge of the citizens of Montreal and to those throughout Canada, who are interested in electrical enterprises, the fact that in the Royal Electric Company the city of Montreal and the Dominion of Canada possess an industrial institution of the highest rank.

We have believed that it would be an especial pleasure to you to become acquainted by actual inspection with the details of an electrical manufacturing establishment within your city and country, which in character of machinery and equipment employed in adaptability to its purpose, and in quality and finish of product, is the equal of any on the continent—second to none.

We have also believed that it would be to you an equal pleasure to see in operation a generating station unique in many particulars, far in advance of stations even in the largest cities, and containing features which are models and standards to which others will conform.

This is the object and purpose which actuated the president and directors of the Royal Electric Company to extend the invitation, which your presence indicates was agreeably acceptable.

The factory and station you have seen to-day represent the utmost development attained to the present moment in the electrical

Wellington streets was leased and became the factory, lighting station, stores and offices of the company.

In July, 1886, the streets of Montreal were first illuminated, 113 lights being placed; to-day nearly 1500 lights in the streets render your city one of the best lighted on the continent.

In 1888 the first incandescent lights were supplied, and a dynamo having the capacity to provide 500 lights was installed. The station which you have just inspected has connected with it and serves at present about 65,000 incandescent lights, besides electric motors and arc lights and is capable of supplying 50,000 more.

In 1889 the generating station, known as the East End station, on Water and Commissioners streets was established solely for arc lighting.

In 1891 the building in which you are at present was built and equipped as a generating station to meet the rapidly increasing demand for incandescent lights.

In 1892 the first electric motor circuit was established.

In 1893 the evident extensive field available in Montreal for the application of electric current directed the attention of the company to the utilization of water power. After an exhaustive examination of all water powers contiguous to Montreal, and after a most thorough comparison of the merits and demerits of each



VISITORS VIEWING THE FACTORY OF THE ROYAL ELECTRIC COMPANY, MONTREAL.

art as applied to light and power purposes and also represent the development and growth of the Royal Electric Company, which has kept pace with the progress of electrical science.

From a beginning in 1884, with a dynamo of 12 light capacity, a work room containing a few ordinary machines, shop tools, a dozen employees, and a capital of less than \$50,000, it has steadily and continuously progressed, so that to-day its generating plants provide electric current for street lights, house lights and motive power to the equivalent of 100,000 16 candle power incandescent lamps, with capacity for 50,000 more; its factory is equipped with the latest and most modern machinery capable of building the largest electrical machinery used in the world, and is now actually at work manufacturing generators of each nearly 3000 horse power capacity; has nearly 500 employees and possesses plant representing \$2,500,000.

It introduced in 1884 a new business in Canada beginning with the manufacture and use of what was then the best and most improved electrical apparatus and continued to be the leader in its line.

To-day it is manufacturing and using generators and other electrical apparatus which are so far superior to those hitherto or elsewhere made in Canada as to be considered, even in the electrical world, a new departure, the improvement is so radical and far reaching.

The company began business in 1884, having both its factory and generating station in a small building in Down street.

In September, 1885, the building on the corner of Queen and

as applicable for electric light and power purposes all were rejected except that of the Richelieu rapids at Chambly, the rights to which were secured by the company.

In 1894 the building at the corner of Wellington and Queen streets, which in 1885 was more than sufficient for all the purposes of the company, was found to be inadequate for the manufacturing purposes alone, and plans were prepared for the erection of a new factory building, so that the factory equipment could be placed therein by the expiration of the lease of the former building on May 1st, 1895.

In 1894 also the desirability of a greatly improved line of electrical apparatus and the opening of new fields for such apparatus resulted in a contract agreement with the Stanley Electric Manufacturing Company of Pittsfield, Mass., for the sole right of manufacture and sale in the Dominion of Canada of the apparatus which they had a short time previously introduced in the United States and which almost immediately assumed first rank as electrical machinery and was recognized by all, who were competent by experience to judge, as being vastly superior to any which had been hitherto produced, and possessing features entirely unknown to the old style of apparatus, features and character of construction which placed it as far beyond all that had previously been made as the marine engines of the ocean liners of to-day are in advance of the ordinary stationary engines of 50 years ago.

This apparatus, known and designed by the initials of the names of its joint inventors and designers, Messrs. Stanley, Kelly and Chesney, being capable of supplying from the same machine and

from the same wires, incandescent lights, arc lights and motors, occupied a new field and made profitably possible the extension of electrical business in directions not hitherto commercially available.

It also occupied a new field, for instead of being the cheap temporary method of construction characteristic of earlier electrical machinery, it is built in the very best manner, equal in every particular in finish and character of manufacture to the best machinery in every other line of commercial practice.

The S. K. C. generators completely revolutionized the method of construction and operation theretofore employed. The particular feature, which in all other generators is the source of constant annoyance, expensive and frequent repairs and loss of service, namely, the revolving wire wound mass known as the armature, with its complicated commutator and constantly wearing and fire emitting brushes, requiring the closest attention of employees and numerous devices for operating and regulating was entirely abandoned and instead is employed simply a solid steel wheel, having contact with no other part and having no wearing or contact surfaces except the journal bearings. To the electrical operator this feature alone was a long coveted boon and is a source of constant delight. To the owners it is a source of great economy and increased net revenue. The record and date of these generators is that the maintenance and repair account has been reduced to nothing.

The S. K. C. system employs the simplest method of what is known as the polyphase system, the development of which has made possible the transmission of power commercially to great distances, thereby opening avenues to the manufacturer of electrical apparatus before impracticable, and enabling the development of otherwise unprofitable water power.

In Canada this field promises to be of prodigious proportions. This class of business usually calls for apparatus of large capacity, and the equipment of the new factory has been planned and carried out to meet this new demand. To the former extensive equipment was added larger tools, among them being two boring mills, one adapted to finish parts of apparatus having a diameter of seven feet, the other capable of finishing parts having a diameter of twenty feet (the latter tool, by the way, being built in the factory itself), a planer, probably the largest of its kind in Canada, also an electric crane capable of hoisting and moving to any part of the building masses of 30 tons in weight, together with several drilling machines, bolt and screw making machines, punches and other accessory tools. Thus equipped the factory is capable of, and is actually at work now in the manufacture of dynamos (namely, those for the Chambly water power), each of which will aggregate in weight upwards of 100 tons and each capable of developing 3000 horse power, being the largest dynamos, except those at Niagara Falls, that have ever been made. Besides these there are being manufactured at the present moment for the Montmorency Company, of Quebec, two dynamos, each of 1000 h. p. capacity, and two each of 350 h. p. capacity, and there have been just completed for a water power, 16 mile transmission plant from Narcisse to the city of Three Rivers, two each of 400 h. p. capacity, and the dynamos aggregating 2500 h. p. capacity, which you have just seen in operation in the station in which you are now, a total for the four places of upwards of 25,000 horse power.

The S. K. C. system is the only one in which dynamos are made to deliver current at very high voltages directly from the generators. Those now in operation at, as well as those being constructed for the Montmorency Company of Quebec, are being operated and will operate at a voltage of nearly 6,000 volts. The Chambly generators will deliver directly from the machines to the lines 12,000 volts. In all other systems the high voltage necessary to convey electric current long distances must be obtained by other devices, known as transformers or converters, the generators usually only delivering a pressure of 1000 volts and the transformers increasing such pressure to the voltage desired. The transformation involves a loss of energy and is a source of interruption and expense, besides its increased cost, which is unnecessary with the S. K. C. system.

The S. K. C. system is alone in this feature, and this characteristic opens the way for the Royal Electric Company to be the advanced leader in the electrical field for light and power purposes, and particularly where the transmission of power to considerable distances, and in large quantities is required. These conditions practically constitute the Royal Electric Company as the engineers for such systems.

Since the introduction in the early part of 1894 of the S. K. C. system in the United States, which was practically first introduced in the early part of 1894, to the present time, there has been put in use or are in process of construction under order in the United States and Canada, generators of this system of a total aggregate capacity of about 900,000 horse power.

Another appliance of the S. K. C. system, namely, the transformer, also revolutionized that necessary adjunct of every alternating current lighting plant, which, as made before the introduction of the Stanley transformer, was a source of the greatest expense to such stations.

Since the introduction by the Royal Electric Company of these transformers into Canada, their value in the prevention of waste has been frequently demonstrated and is now so firmly established that every electric lighting station, in the endeavor to improve its earning capacity, is displacing the old types of transformers, which have been in use and substituting therefor S. K. C. transformers.

Although first offered to the electrical public but a few years ago, there are in use to-day S. K. C. transformers having an aggregate capacity of upwards of 1,000,000 lights, and the demand for them is constantly increasing.

The peculiar success of the S. K. C. system is due to the new features and principles it embodies, but is also equally due to the extremely high character of the methods and materials employed in manufacture. These methods require the utmost accuracy, the greatest care, the best materials and the finest finish.

The manufacture by the Royal Electric Company of the S. K. C. apparatus is carried on in direct accordance with the plans, specifications, drawings and methods in use by the Stanley Electric Mfg. Co. in their own works, and in every detail and particular are exact duplicates of those made by them. All the advantages of contact with the widely extended field covered by the Stanley Company in the United States are available to and at the disposal of the Royal Electric Company, and are utilized for the benefit and are at the service of its customers.

The factory is planned, equipped and manned for the manufacture of high class apparatus only, and is devoted solely and entirely to work of that character. When the introduction of this class of electrical apparatus was begun by us we were told by some of our good friends that there was no market in Canada for this class of goods. Our experience during the last two years fully and completely refutes that suggestion, for we have found that when we made known in actual practice the fact that electrical apparatus of this character was available, the best and only the best was wanted, and the result is the condition of our factory to-day—engaged to its utmost capacity in the fulfilment of orders, being in many cases repetitions of previous orders.

The S. K. C. system, however, does not constitute the entire business of the factory, the manufacture of direct current dynamos and motors, arc lamps and machines, and railway generators and motors adding materially to the demands on the capacity of the works; a recently completed order being the entire new equipment of generators and motors for the Montreal Park and Island Railway Company.

The manufacture of insulated wire and of many kinds of instruments and other appliances is extensively carried on, and since the beginning of the business of the company it has installed in Canada 70 arc light plants, using an aggregate of upwards of 8,000 arc lamps, and 145 incandescent plants, with a total capacity of more than 250,000 lights, distributed from Victoria in the west to Prince Edward Island in the east.

Judging, therefore, by the past of the Royal Electric Company, and by its present conditions and demand for its manufactures, with the large new opportunities opened by its S. K. C. system, the future bids fair to tax the capacity of this complete factory to its utmost working power night and day. At the present day, the business already in hand will keep it constantly occupied at least during the present year, working day and night.

With such improved apparatus available, it became incumbent upon the Royal Electric Company to utilize in its own illuminating business the advantages obtainable from the S. K. C. system. To that end about a year ago the board of directors authorized the improvements which have been recently completed in its lighting system—these improvements being the placing of Stanley transformers upon its lines of the S. K. C. generators, which you have just seen, in this station, and the erection of the new distributing switchboard.

One of the advantages resulting from these improvements, which will appeal directly to our shareholders, is that with more than 10,000 lights connected to the station at the present time than there were a year ago, and although the improvements have practically been only just completed, an economy has been accomplished in the item of fuel to the extent of 6,000 tons; that is, there was consumed during the year 1896, with the increased business, 6,000 tons of coal less than during the year 1895.

When the improvements within the station were begun a year ago, the four engines, two of 500 h. p. capacity and two of 1,000 h. p. capacity each, were connected to some thirty separate dynamos by means of lines of shafting on two floors of the station. As you have just seen, three of these engines are connected directly by belting directly to what are practically three dynamos, the fourth engine being at present not required.

Any of you who saw this station a year ago will remember that the entire space of the first and second floors was completely filled with shafting, pulleys, belting and dynamos, and both floors presented an exceedingly crowded condition. As you have perceived to-day, the first floor alone fulfils all the purposes of the station, and its condition is open, roomy, bright, cleanly and cheerful.

The switchboard, which bears the same relation to our lighting and power systems as the pilot house does to a steamship, and controls the distribution of the electric current from the generators to the premises of our customers, has been especially designed and constructed with two important considerations in view; the first to secure an entirely incombustible condition, the second to obtain a flexibility and facility of operation which will enable the transfer of any circuit to or from any generator so quickly as to be practically imperceptible when all the lights are burning.

The first condition of incombustibility is a necessity to insure permanent service to our patrons, and has been completely accomplished. The second condition secures uniformity of service to our customers, a condition which we have abundant reason every day to realize has also been accomplished.

The switchboard is so arranged that any circuit, with every light thereon burning, may be instantaneously transferred from one generator to another without perceptible change in the light, and this is done so frequently without being noticed that it is the best possible evidence of the complete adaptability of the switchboard to its purpose.

A fact in connection with these improvements and the change from the old system to the new is, that all of these changes were made without the interruption for a single instant of the service to

the upwards of 60,000 lights served from this station, which is in operation continuously during every hour of every day in the year.

To those familiar with the handling of electric currents, this will seem a feat almost without parallel; and even to those who are not familiar a consideration of the labor, risk, care and rapidity of action involved in transferring nearly 100 wires, all of them charged with electrical current, from nearly 30 dynamos and the old switchboard to 3 dynamos and the new switchboard without the least interruption, will represent a work of great magnitude.

This entire change from the old system to the new, from the old to the new switchboard, was made within the period of ten hours, our customers obtaining their service undisturbed.

The dynamo room and the switchboard are models in arrangement, with abundance of room, ready opportunity for attention, and complete capability of control and manipulation.

As the generators are of the two-phase system, we are able to furnish from the same machines and on the same wires incandescent lights, arc lights and motive power, and we are now prepared to furnish current for motive power purposes in any part of the city, and can furnish such power measured by meter, the same as incandescent light is used.

All of this work and all of this apparatus within the station has been placed not only for the purpose of improving our present system of electric lighting and increasing the opportunity for the use of electric currents for motive power, but it has also been done especially with a view to being utilized in connection with the electric current to be transmitted from the water power generator plant at Chambly.

The switchboard has been constructed so as to be capable of handling and distributing current for upwards of 200,000 incandescent lights and equivalent capacity in electro-motive power.

The generators at present operated by the steam engines are designed to be operated by the electric current from the Chambly water power as motors, wherewith will be operated the necessary complement of arc light dynamos to serve current for all the arc lights in the city streets and public places, as well as to operate the direct current generators now supplying current for motive power. The circuits for such direct current motive power will be maintained, so that customers having motors available for use on such current can be supplied with such power.

Within this station will be placed transformers to reduce the high voltage on the lines from Chambly to that used for distribution throughout the city. This current will be conveyed to the present switchboard and thence to the lines already extending throughout the city, and also to the generators, which will then become motors. The entire system of lighting and power now carried on in this station and at the east end station will be served entirely from here, as will also any additional current required for increased business, the entire distributing system being concentrated in this station, with practically no alterations in the present equipment.

The east end station will be maintained in its present condition as a steam generating arc lighting station, to be used as a relay or emergency station only. The steam engines in this west end station will also be retained in their present position, and in the extremely remote contingency of an interruption from any cause in the delivery of the current from Chambly, the motors will immediately again become generators and perform the functions they are now fulfilling. With this arrangement there will exist a water power plant and a steam plant entirely independent of each other, insuring absolute continuity of service.

The maintenance of the east end station in its present condition and the arrangement of this west end station, so as to be promptly transformed again into a steam generating station, is a precaution taken against what is assuredly a very remote contingency, but it has been so arranged in order to remove all opportunity for interruption of service to our customers.

That there is extremely little chance of interruption in the delivery of current from the Chambly water power into this city may be determined by a consideration of the conditions entering into its development, and at this juncture it is appropriate to speak of the Chambly water power generating and distribution of electric current therefrom.

The dam being built is to be one homogeneous mass of concrete, forming practically a monolith or a structure made of but one stone. This dam has been designed and is being built under contract by the foremost hydraulic engineering company on this continent according to the plans and under the direct supervision of its chief engineer, who is recognized as the most competent authority in this character of construction.

The wheels are also to be provided by and are under contract with the same engineering company.

The entire hydraulic work has been contracted with the above mentioned company under guaranteed results, among which are the maintenance, at all times, of a working head of 28 feet and the delivery to the shafts of the electrical generators of not less than 20,000 horse power. There will be eight units or sets of wheels, each of a capacity of 2,650 horse power. Each of these units or sets of wheels will be connected directly without the intervention of any gearing or appliance to cause loss of energy to the shaft of one electrical generator,—in fact, the shaft of each set of water wheels and of each generator will be practically one continuous shaft, thereby reducing to a minimum the loss of energy and the occasion for the expense of repair.

Besides these eight sets of wheels and generators, (the generators we have already described as being under construction in our factory, and each of which will weigh 100 tons) there will be two sets of water wheels, each operating an exciting generator of capacity sufficient to supply the excitation current required by all of the generators.

The dam, as stated before, will produce a head of water 28 feet

in height and will utilize the entire water of the Richelieu river, the outlet of Lake Champlain. The reservoir or head race thereby created will extend up the river from the dam to a point where the level of the water in the head race will merge with the natural level of the river, such point being a mile and a half or more above the dam, thereby securing a very long deep mill pond, which, with the high working head of 28 feet, will effectually remove all possibility of that bug-bear of water powers in cold climates,—frazil.

The location of the dam has been selected at a point where the highest known rise of the water in the Chambly basin below the dam will not affect the level of the tail race. Therefore all possibility of interruption due either to frazil or back water is completely removed.

The character of the construction of dam, power house, wheels, dynamos, switchboard, is all of the highest order. There are no gears to wear or break, there are no wire-wound armatures liable to destruction, there are no commutators, brushes or wearing parts in the dynamos, the only wearing parts in the water wheels and electrical machinery being the shaft and its bearings,—consequently every source of danger has been apprehended and guarded against.

The current will be conveyed from the power house at Chambly to the city of Montreal by two separate lines of poles and wires. Should an accident happen to any part of either line of poles or wires necessitating repairs, the current required will be transmitted by the other line during the time such repairs are being made. This will permit such repairs to be made without interruption to service or danger to employees, because there will be no current passing over the line being repaired as the other line will carry all that is required.

Arrangements have been consummated with the Grand Trunk railway, whereby the wires for the crossing of the St. Lawrence river will be carried on the Victoria bridge, and there also the wires will be so placed that a duplicate system corresponding to the duplicate pole line will be provided. The same duplicate system will be employed within the city from the bridge terminus to the distributing station. No danger of interruption from injuries to pole lines can therefore be apprehended.

All the work and material for the Chambly water power electrical transmission plant is under contract to be completed by September 1st, 1897. The progress already made in all the various parts of the work assures completion in accordance with the contracts, so that in September of this year, this west-end station, which is now a generating station of large size, will become merely a distributing or sub-station of the one at Chambly, the second largest electrical generating station in the world.

The advent of the electric current from Chambly will create new conditions in the city of Montreal.

The low price at which electric current can then be supplied will permit its use in many directions not now considered.

Its use for illumination will naturally become greatly increased, but the greatest advantages from it will accrue to commercial interests. Motive power will be available at rates which will not only render it profitable for present users of steam power to abandon it, but numerous new industries will be attracted to and established in the commercial metropolis of Canada where, in addition to the many other advantages it possesses, power will be as inexpensive to the manufacturers as if they were located directly upon some water fall with the usual disadvantages and expense of inaccessibility and inconvenience. It must have a direct, immediate, and permanent beneficial influence upon the value of real estate in the city and vicinity because of the largely increased demand for land required for additional manufactories. The appearance of the city, as well as its hygienic condition, and, therefore, also its value, will also be greatly improved, for, as it will be unprofitable to operate steam plants, they will be discontinued and soon will disappear with their necessary accompaniment of that black smoke which produces the dark, murky cloud that now so often hangs like a dismal pall over the city, shutting out its beauty, begriming its buildings, soiling the furnishings and decorations of its residences as well as the clothing and persons of the inhabitants, and impregnating the atmosphere with matter detrimental to health.

Besides accomplishing these material benefits in the commercial interests of the city, the electric current from Chambly will become the handmaid of domestic service, will lighten the labors of the household, affording the means of cooking and heating without the labor of handling coal and ashes, or the disagreeable adjuncts of scorching flame or of offensive odors; making easy and agreeable the service of the kitchen, laundry and the sewing room, and, most important of all, with these results will come vastly increased safety from fire; your insurance statistics will indicate most graphically the numerous sources of dangers in this respect which will be removed by the extended use of the electric current above outlined.

The diminished cost of electric current for illumination will very extensively increase the use of light; exteriors as well as interiors of buildings and windows will be illuminated for decorative effect; public or street lighting will not alone be extended into every street, by-way and lane, but will be increased in number in every street, which will be possible within reasonable expenditure, and the city will become bright, cheerful, healthful and clean, and its streets at night will be as safe as under the glare of the noon-day sun. This is no idle anticipation nor a fanciful picture, but a very probably near-by reality.

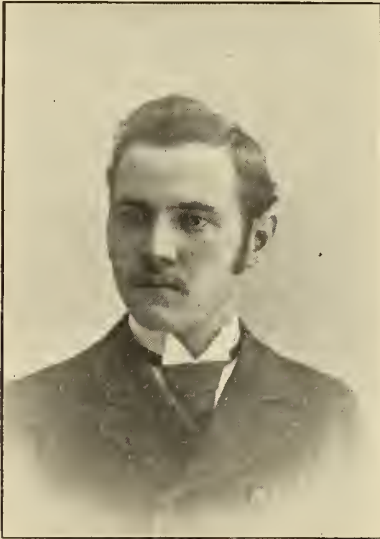
The successful progress of the Royal Electric Company is a component of the increased prosperity of the city of Montreal, and through the use of its manufactures, the Dominion will obtain similar advantages.

We can, therefore, anticipate with pleasure as the result of your visit here to-day a more intimate knowledge of the Royal Electric Company, and in consequence not only your good wishes but your valuable friendly aid and assistance in promoting its enterprises to broader dimensions and still greater successes.

After making a thorough inspection of the lighting station and factory, under the direction of the officers of the company, the health of the President was proposed by Ald. Stevenson, and replied to in suitable terms by Senator Thibeau. In proposing the health of the general manager, Mr. Browne, Alderman Sadler remarked that Montreal was the best lighted city in America. A toast to the heads of the departments, proposed by Lieut.-Col. Strathy, was responded to by Mr. P. G. Gossler, chief electrician. After congratulatory speeches by Messrs. Frank Badger, Jr., John Morrison and D. Parigau, M. L. A., the company sang the National Anthem and Auld Lang Syne, and separated.

MR. WILLIAM THOMPSON.

WE have the pleasure of presenting to our readers the accompanying portrait and sketch of Mr. Wm. Thompson, the author of the series of articles on "Chemistry in the Boiler Room," and other contribu-



MR. WILLIAM THOMPSON.

tions which have recently appeared in the pages of this Journal, and which, we doubt not, have been read with interest and profit.

Mr. Thompson was born and educated in the home of the iron trade, Middlesbro, Eng. In 1883 he came to Canada, and found employment in Toronto and Brampton until 1891. Since 1891 he has been employed by Armstrong & Cook, as superintendent and chief engineer, operating their waterworks and electric light plant at Montreal West, Que. Both the electric and waterworks systems were installed under his supervision.

To thoroughly equip himself and master all the details of his profession, Mr. Thompson has taken a special course in analytical chemistry under the tuition of the well-known chemist, Prof. J. T. Donald, of Bishop's University, Montreal.

It may be safely predicted that Mr. Thompson's ambition, coupled with ability and push will yet place him in the front rank of engineers.

WORTH TWICE THE PRICE.

MR. G. Coop, Regina, N. W. T., in remitting his subscription to the ELECTRICAL NEWS, writes: "Your paper is worth twice the money."

QUESTIONS AND ANSWERS.

IN reply to Jas. McPherson's enquiry in your last issue, I beg to say that an injector should work under conditions stated; provided, of course, his injector is in good order, and feed pipe of ample area so as to reduce friction to lowest margin. I understand him to say his Blake pump has to force water a distance of 80 feet horizontally, and then go vertically, and receives its supply of water under pressure of from 20 to 40 pounds pressure. Cause of knocking is most likely poor adjustment of suction valves, which are probably adjusted to work at atmospheric pressure. Run your cold water into a barrel for a while and pump from this, and see if knocking disappears. If it does, set the spring on your suction valves to work at cold water pressure, or pump from a tank using ball-cock to regulate supply of water; the latter course is recommended.

WM. THOMPSON.

A. M. S., Manitoba, writes: "Can you tell me anything about this acetylene gas of T. L. Willson's of Hamilton? A man is getting it up here, and if his accounts be true there will be no electric light in the world in a few years."

ANSWER.—Acetylene gas has been known for many years, but it is only within the past few years that a method of producing it by electricity has been discovered. The value of an invention of this kind may be estimated from the length of time it takes to become universally used. If acetylene was able to displace electricity as an illuminant, it would probably have made more progress during the several years since its discovery. The fact is that there are many drawbacks to its use. Some people go so far as to say that some of these are so nearly insuperable as to make it certain that acetylene will do no great amount of displacing for many years to come. There are usually two sides to every question, and while much may be said in favor of acetylene, it has been found that the care and attention required in its use, together with its liability to explosion, are likely to prevent it from becoming very popular. This is without taking into account its expense.

"Operator," Millbrook, Ont., writes: "I would like to know what is the nominal candle power of an alternating arc lamp, taking 10 amperes and 28 volts. The lamp is of the Kester make."

ANSWER.—There is no recognized standard of nominal candle power of arc lamps, but 9.6 amperes and 45 to 50 volts is usually considered 2000 candle power.

"R. B." writes: "The area of the base of a cone is 450 sq. inches, what must be its height that its volume may be 1 cubic foot?"

ANSWER.—

$\frac{1}{3}$ altitude $\times$ area of base = volume of cone.

$\frac{1}{3}$ altitude $\times$ 450 = 1 cubic foot = 1728 cubic inches.

$\therefore$ altitude = $\frac{1728}{150} = 11.52$ ".

From this can be quite readily found the length of the slant side.

$$\text{length} = \sqrt{\left(\frac{\text{diameter of base}}{2}\right)^2 + \text{altitude}^2}$$

$$\text{and as the diameter} = \sqrt{\frac{540}{\pi}} = 23.9"$$

$$\therefore \text{length} = \sqrt{11.95^2 + 11.52^2} = 16.6"$$

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

NOTE.—Secretaries of Associations are requested to forward matter for publication in this Department not later than the 25th of each month.

HAMILTON NO. 2.

At the last meeting of the above association, Mr. Stobbs gave an illustration of the working of the planimeter, and Mr. Norris showed the difference between the working of a slide valve with and without lead.

LONDON NO. 5.

The regular meeting of London No. 5 was held on Thursday, the 18th inst. It was reported that during the past two months the membership had been doubled. Mr. St. John, boiler inspector, of Toronto, was present, and answered many questions pertaining to engineering asked by the members. He impressed upon the engineers that valuable life and property were entrusted to their care, and that their responsibilities were great. Constant care and skill were necessary, and at times great presence of mind would prevent the breaking down of an engine, and even the explosion of a boiler. Mr. St. John lectured at some length on the steam boiler, and a hearty vote of thanks was tendered him by the association for his kindness.

KINGSTON NO. 10.

The members of Kingston association held an open meeting on the 18th ultimo, which proved to be one of the most interesting and instructive yet held. The president, Mr. Fred. Simmonds, opened the meeting with a few brief remarks, and called upon Ald. Elliott, who read a carefully prepared paper on "The Main House Trap and its Application from a Sanitary Standpoint." Mr. Harry Breck followed with an illustrated paper on "The Manufacture of the Incandescent Lamp," and a contribution on "The Steam Indicator," was given by Mr. McEwen, which will appear in the April number of the NEWS. A paper on "Gas and Its Manufacture," written by Col. Kerr, superintendent of the Kingston Gas Company, was read by John Orr, and Bro. S. Donnelly gave a short talk on "Valve Motion," after which a hearty vote of thanks was tendered to the authors.

Bro. Geo. Hazlett, past-president of the Winnipeg association, who is a former resident of Kingston, was present, and gave an outline of the order in the west. He spoke of boiler inspection certificates, and thought that Ontario was rather behind some of the other provinces in this respect. Open meetings of the association will be held every three months.

POINTS ON SHAFTING.

THE author of a paper on "Shafting in Factories," presented before the American Society of Mechanical Engineers, summarizes his conclusions on the subject as follows:

It seems to the writer that in ordinary machinery establishments an observance of the following rules might effect a saving that would be noticeable in the annual balance.

1. Use pulleys of large diameter on counters and narrow fast-running belts.

2. Use nothing but the best oil and plenty of it, catching all drip, and either purifying it or using it for some other purpose.

3. Have all the shafting and counters oiled regu-

larly and do not depend too much on automatic oiling.

4. Inspect line shafts from time to time, and see that they are in line and can be turned easily.

Many line shaft boxes bind at the sides when screwed down, sometimes increasing the turning moment 100 per cent.

THE NATIONAL TUBE WORKS.

AMONG the largest producers of pipes and tubing in the United States is the National Tube Works Company, of McKeesport, Pa. Being located practically at the mines of the greatest bituminous coal deposit of the world, with an abundant supply of lime, coal and iron ore, they operate under most favorable circumstances. The works were first established in Boston in 1865, and in 1872 the company built a small mill at McKeesport. To-day the works extend for a mile along the bank of the river and from nine to ten thousand men are employed. The annual capacity of tubular goods is over 250,000 tons, and the company are said to be the largest manufacturers of charcoal iron boiler tubes in the world. Owing to the rapid growth of steel making, in the year 1892 a complete steel plant was built near their blast furnaces, which enabled the company to control every stage in the process of manufacture from the raw iron ore to the finished pipes and tubes. The pipe mills are large enough to take nearly the entire product of the steel works, by which they are enabled to make for their pipe mills the highest quality of mild steel, of a special grade.

The blast furnace consists of two modern stacks, 80 feet high and 20 feet internal diameter. The power is furnished by a 3,500 horse power battery of boilers, and the average output is 18,000 tons of Bessemer pig iron per month. The steel plant comprises two eight ton converters and a 35 inch blooming mill with the necessary appliances. One of the features of the plant is the immense horizontal compound condensing blowing engine, the largest one turned out up to the time of its installation.

The boiler plant is also noticeable. It consists of about 2,500 horse power of the water tube type; all boilers fitted with automatic stokers. Slack coal is the only fuel used. The output of both the blast furnaces and the steel plant is especially limited by the fact that such great care is taken throughout to be sure that the highest possible grade of steel is produced. Six complete puddle mills are also kept for running when occasion requires for making iron piping. The rolling mill department consists of 14 different mills adapted to the various sizes of skelp required.

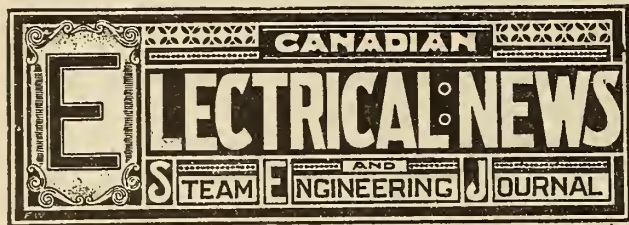
The tube works proper is most interesting. The pipe mill where the small gas and water pipe is made contains seven welding furnaces and other necessary machines. The lap-weld mills, where the boiler tubes and larger sizes of pipe are made, contain ten double bending furnaces and twelve welding furnaces. Pipe up to and including 24 inches is regularly made, and plans are under way for making pipe 30 inches in diameter. A new furnace recently completed is of a novel construction, and furnished with new electrical appliances. The pipe mill department also contain two large machine shops, a forge for making couplings for the pipe, a foundry, and numerous minor departments. The fuel used throughout the works is artificial gas, known as "producer gas," furnished by about 75 producers. After the pipe is welded, it is inspected throughout, tested to the stipulated number of pounds to the square inch of internal hydrostatic pressure varying from 300 to 5,000 pounds, and after a final inspection the goods are ready for the consumer.

As offering some faint idea of the varied and intricate details connected with this establishment, it needs but to be suggested that, from the one-eighth inch gas pipe to the huge 24 inch water, oil or gas main, there are above 1,000 several and different sizes of tubes turned out by this establishment, and on its blanks as carried regularly in stock.

In the process of manufacture an elaborate system of tests is employed from the beginning until the end, and every precaution is taken to ensure the most perfect result possible in modern skill and science.

The National Tube Works Company is capitalized at \$11,500,000, and has offices at Boston, New York, Pittsburg, Chicago, St. Louis and London, England.

The Valley Telephone Company held their annual meeting at Middleton, N. S., last month. Judge Savery was re-elected president, and extensions to the line were decided upon.



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Advertising rates sent promptly on application. Orders for advertising should reach the office of publication not later than the 25th day of the month immediately preceding date of issue. Changes in advertisements will be made whenever desired, without cost to the advertiser, but to insure proper compliance with the instructions of the advertiser, requests for change should reach the office as early as the 22nd day of the month.

SUBSCRIPTIONS.

The ELECTRICAL NEWS will be mailed to subscribers in the Dominion, or the United States, post free, for \$1.00 per annum, 50 cents for six months. The price of subscription should be remitted by currency, registered letter, or postal order payable to C. H. Mortimer. Please do not send cheques on local banks unless 5 cents is added for cost of discount. Money sent in unregistered letters will be at senders' risk. Subscriptions from foreign countries embraced in the General Postal Union \$1.50 per annum. Subscriptions are payable in advance. The paper will be discontinued at expiration of term paid for if so stipulated by the subscriber, but where no such understanding exists, will be continued until instructions to discontinue are received and all arrears paid.

Subscribers may have the mailing address changed as often as desired. When ordering change, always give the old as well as the new address.

The Publisher should be notified of the failure of subscribers to receive their paper promptly and regularly.

EDITOR'S ANNOUNCEMENTS.

Correspondence is invited upon all topics legitimately coming within the scope of this journal.

The "Canadian Electrical News" has been appointed the official paper of the Canadian Electrical Association.

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MR. R. S. Hale discusses, in the Engineering Magazine for February, the relative economy of electric current supplied by a large central station as compared with an isolated plant. He concludes that the economy is largely on the side of the large station, for the following reasons: The isolated plant is more expensive in first cost, excepting only the items of boilers and street conductors; if all the expenses are included, the cost of operation of an isolated plant is far greater than that of a central station. He therefore contends that it is cheaper for the real estate man, the hotel-keeper, or the drygoods merchant to devote his brains to making money in his own field, where he is an expert, than to waste his time on a small electric plant.

Improvements in Water Wheels.

THE utilization of water power for the economical generation of electricity for light and power, besides creating a market for water wheels, is directing attention to the subject of water wheel design. The decrease in milling operations in Ontario in recent years, coupled with the total or partial failure of quite a number of water powers, led to the increased use of steam, with the result, we believe, that improvements in water wheel design and manufacture have scarcely kept pace with those in appliances for the generation of steam. As already stated, however, the increasing use of electricity is calculated to change this condition, and lead to the most careful attention being given to the design of water wheels, so as to secure the utmost generating power combined with the most economical use of water. At the recent exhibition at Geneva there was an interesting display of wheels, in which the Girard and Pelton types predominated. The horizontal type seemed to

have the preference, however, for low heads. A noticeable feature in all was the highly efficient regulators for use in the generation of electricity.

Improvements in Arc Lamps.

SPECIALLY noticeable during the last six months has been the wonderful improvement made in arc lamps for use on constant potential circuits—both direct and alternating current. That this is a very important matter will be evident to any station manager who is frequently asked for an arc light for a store, and whose street circuit is already full. In fact there are many cases where street lighting on the constant potential arc system would be actually preferable to the usual series system, and in the larger towns where a considerable part of the expense is the wages of lamp trimmers and carbons, the saving effected by using the long burning arcs, on the highly efficient D. C. machines would amount up to a very appreciable figure. There are many cases where an arc might be placed in front of a store window, or in the office of a hotel, and as it would have to be lighted at ordinary commercial hours, it would not be possible to put it on the street circuit. The difficulty, however, is solved, and business secured by this lamp, which is placed as an ordinary incandescent.

Canadian Electrical Association.

At a largely attended meeting of the Executive Committee of this Association held on the 25th inst., preliminary arrangements were made for the annual convention to be held at Niagara Falls, Ont. Wednesday, Thursday and Friday, the 2nd, 3rd and 4th of June, were selected as the dates for the convention. Committees were appointed to make the necessary arrangements and to secure papers. A number of valuable papers have already been promised, and the outlook for the meeting is a most promising one. Niagara Falls is at the present time the most interesting and instructive spot in the world for persons interested in the development of electricity. The enormous works of the Cataract Construction Co., the construction of which was in progress on the occasion of the previous visit of the Association to the Falls, are now in successful operation. Here are to be seen the largest generators in the world, and all the accompanying apparatus for the supply of electrical energy on an enormous scale. The line for the transmission of power to Buffalo, a distance of upwards of 20 miles, is also now in operation. These works will be open for the inspection of the members of the Association, and, combined with many other attractions, will tend to make the occasion a memorable one.

Fuel Economy.

WE would draw the attention of managers of steam operated electric stations, to the advantages to be derived from the use of fuel economizing apparatus—more especially so when, as is very frequently the case, the class of operative responsible for the generation of steam is by no means really competent to get as much good out of the fuel as possible. Owing to either poor design of boiler settings, or injudicious chimney and flue proportions, and largely to poor firing, the temperature at which the heated gases escape from the furnace into the chimney is greatly in excess of what would be necessary to produce a good draught, and any means whereby such excess of temperature can be made use of

is an evident saving. Probably the best way of utilizing this excess heat is to raise by it the temperature of the feed water, by causing the pipes conveying this feed water to pass through a special chamber in the chimney base and so come in contact with the escaping gases on their way from the boiler. Of course such an arrangement costs money, but the savings effected thereby are sufficiently appreciable to make it really worth while considering the question. To give a simple illustration of the gain in heating feed water, suppose a 1000-light plant, operating from dusk until daylight every night throughout the year, condensing, with coal at \$3.50. The water in the hot well will probably be at about 100° F., and has thus to be raised 112° before steam is generated. Such a plant will have an average throughout the year of about 500 horse power hours nightly, and 182,500 horse power hours for the year. The water required to be evaporated into steam will be somewhere about 75,000 gallons, and this has to be raised in temperature from 100° to 212°. To do this will be required not less than 50 tons of ordinary coal, which at our price is \$175. An efficient waste heat economizer would not cost \$1,000; the interest on the investment would be say \$60, and the other \$115 a clear gain. With a good economizer, as a matter of fact, the feed water can be raised to much above boiling point. We commend this to the careful consideration of our readers.

Central Station Management.

THE days of hap-hazard methods in the management of central stations for the supply of electric light and power are rapidly passing away. There are men to be found in this, as in other lines of business, who fail to heed the signs of the times, and who make little or no effort to keep abreast of the progress which is constantly taking place. The fate of such men is not difficult to predicate—sooner or later they will find themselves forced out of the business by their more progressive competitors. It is not going too far to say that every owner and manager of a central station who neglects to inform himself with regard to the latest improvements in machinery and operative methods is assisting to bring into use other forms of illumination, and is likewise placing arguments in the mouth of the advocates of municipal control. In view of the efforts which are being made to supplant the electric light, and to transfer the electric lighting business from private companies to the hands of municipal corporations, it behooves the owners and managers of central stations to bestir themselves to acquire exact knowledge of the latest improved apparatus and methods and the ability to apply this knowledge to the conduct of their business, so as to be able to furnish light and power in the most efficient manner, and at the lowest possible cost to producer and consumer.

A combine is announced to have been organized in the United States to regulate the prices of incandescent lamps.

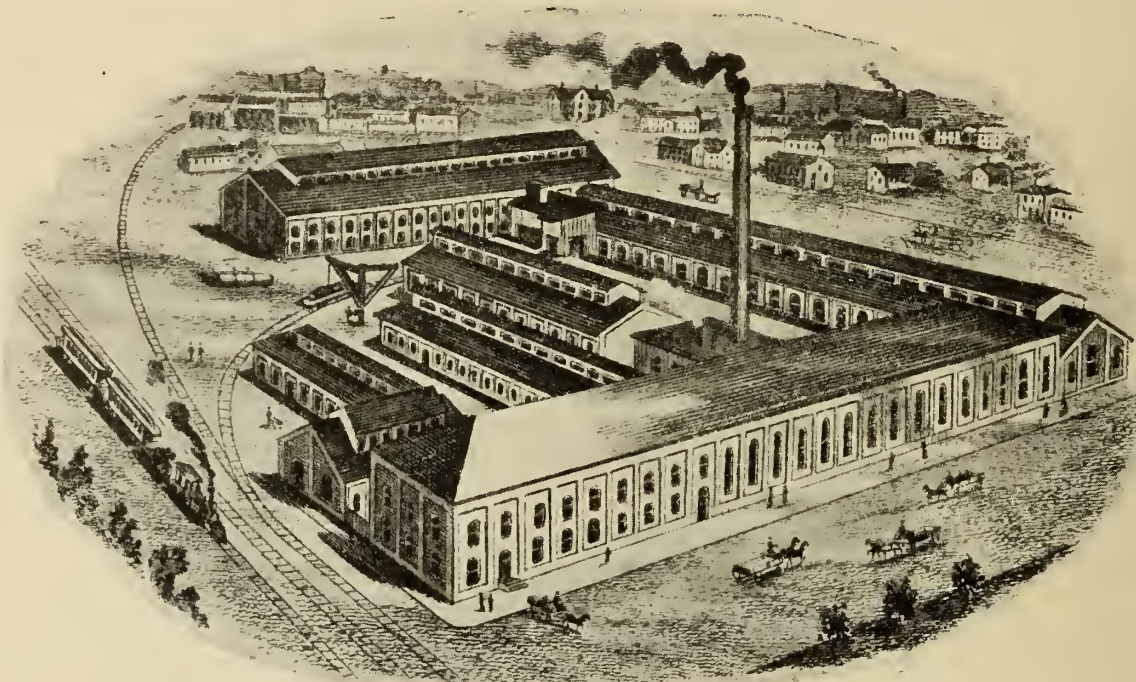
It is reported that the Kootenay Water Supply Company and the Kootenay Hydraulic Mining Co., of British Columbia, who have extensive water powers at Waneta and on the Pend d' Oreille, propose to amalgamate, with the object of utilizing in Rossland and other mining camps the 10,000 horse power they control. A large electric plant will be required, the distance being fifteen miles.

A NEW APPLICATION OF ELECTRICITY.

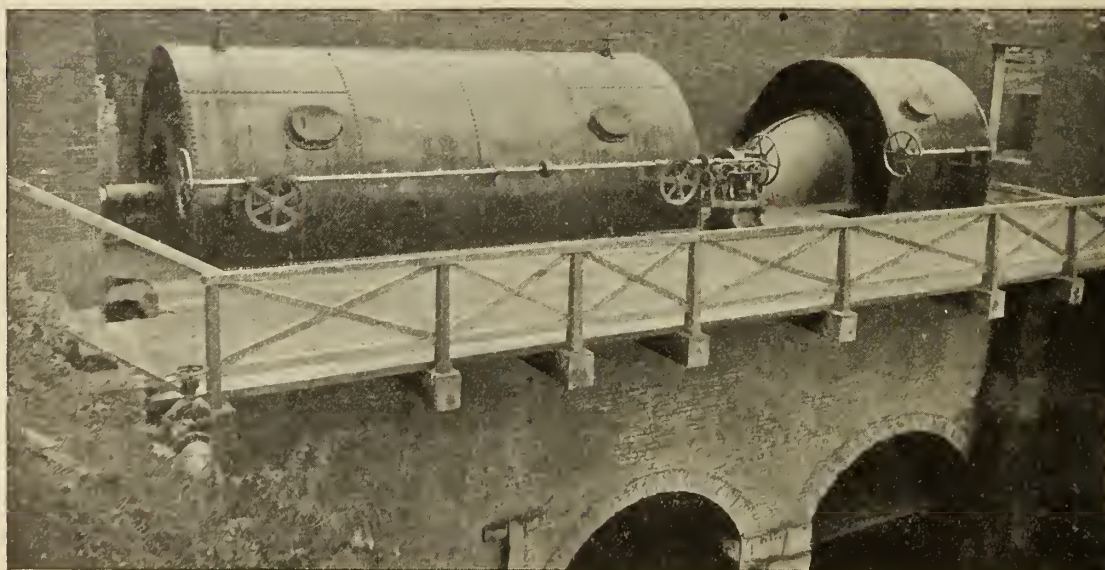
THE introduction of electric power in the operation of the refrigerating plant of the Quebec Storage Company, in Quebec city, is another new field for central stations, with which to increase their day load. The plant being installed to drive the refrigerating machinery consists of two 50 and two 15 h.p. two-phase "S.K.C." induction motors; the larger of these motors are to be for the operation of the compressors and are now being set up, replacing two engines. These motors are belted

shafts arranged so that by friction clutch they can be made one. Each of these motors is arranged to operate on a fan for driving air over the pipes to be cooled, and also for operating a pump for the circulation of the brine. In this case also by the use of the friction clutch, either motor can operate one or both shafts and pumps. Each of these two 15 h.p. motors is also used to operate a freight hoist and can be used interchangeably.

The current for driving this plant will be supplied by the Montmorency Electric Power Company from their



WORKS OF THE S. MORGAN SMITH CO., YORK, PA.



The engraving represents a line of horizontal McCormick Turbines, consisting of one pair and one single 51 inch in iron cases. These turbines are developing 2,700 horse-power, which is taken off at one end of the shaft and is used in the cotton mill of the John P. King Manufacturing Company, Augusta, Ga. The McCormick wheel is the invention of John B. McCormick, who also invented the Hercules wheel. The McCormick is his latest invention and embodies points of merit in its construction which are not found in other turbine named. It is very heavy, strong, well built and nicely finished.

direct to two lines of shafting, which are so arranged that they can be made one continuous line by a friction clutch, the intention being that, if necessary, either motor can operate both compressors, or either one of them as circumstances may require, the compressors being driven by belting from the shafting described. From this same shafting will also be operated two pumps, which are used to bring about a circulation of the brine in the pipes.

The two 15 h. p. two-phase "S. K. C." induction motors will, in a like manner, be connected to two

two-phase "S. K. C." generating plant at Montmorency Falls, fully ten miles distant from the Quebec Storage Company's warehouse and refrigerating plant and thus, as above noted, superseding a steam plant, which has been in operation for the last few years, and it was found that the operation of the plant would be much more satisfactory and more economical by electric than by steam power.

The entire electrical plant is to be in operation by the first day of May next. The "S. K. C." two-phase motors, as well as the auxiliary apparatus necessary thereto, are being supplied by the Royal Electric Company, of Montreal.

CHEMISTRY IN THE BOILER ROOM.

By WM. THOMPSON, Montreal West.

PART III.

As already stated, carbon and oxygen enter into combination in two different proportions, and form two new chemical compounds, one of these being the result of perfect and the other the result of imperfect combustion.

The first of these is known as carbon dioxide or carbonic acid gas, and written symbolically CO_2 , meaning that two atoms of oxygen have combined with one atom of carbon to form the new chemical compound carbon dioxide, and as a result of this combination a given quantity of light and heat was given off at the exact time that combination between the two elements took place. It should be carefully noted that neither light nor heat is given out from the coal nor yet from atmospheric air themselves, until the two elements under consideration are brought into combination with each other under certain defined conditions, and that there is neither loss nor gain in weight as a result of heat having been given off. Nature provides that each element shall have a fixed atomic weight, and this has been fixed by chemists for carbon at 12 and for oxygen at 16; therefore, if carbon and oxygen have entered into chemical combination to form carbon dioxide the product will have a given weight; and if you take, for example, one pound of carbon and admit just sufficient oxygen to form carbon dioxide, you will require to admit $2\frac{3}{4}$ pounds of oxygen, and as a result will produce a certain quantity of light, a given quantity of heat, and exactly $3\frac{3}{4}$ pounds of carbon dioxide; although a direct and distinct change has taken place in these two elements; the carbon has disappeared as carbon in the solid state and oxygen has also disappeared as oxygen in the gaseous state, and a new gaseous compound has been formed having volume according to temperature and a weight corresponding exactly with the weight of the two elements combined before chemical combination took place. As a matter of fact both light and heat have been given off, still we have no loss in weight, proving conclusively that heat is not a substance stored away in the coal nor yet in the air, but is simply a result of the two elements, carbon and oxygen, having entered into chemical combination, and must be given off at the exact moment combination between the two elements takes place.

The new chemical compound CO_2 has its own peculiar properties, and is neither combustible nor yet a supporter of combustion. It will not burn for the same reason that water will not; it has combined with all the oxygen it is capable of, and has practically the same effect on our fires, and must be got rid of just as soon as formed. Under equal conditions of temperature it is heavier than atmospheric air, a fact that will readily impress mechanical minds.

There is, however, another important chemical compound formed during the combustion of fuel, and already referred to as carbon monoxide, written symbolically CO . In this case only one atom of oxygen combines with one atom of carbon—the two elements combining in equal proportions to form CO —this as I have stated being the result of imperfect combustion. To an unlearned fireman there is apparently no difference between the two products CO and CO_2 —they are both compounds of carbon and oxygen, and in each case the carbon disappears and combines with oxygen to form a new gaseous compound, and during the act of combination in each case both heat and light are given off, but in vastly different proportions.

Roughly stated, CO may be said to have formed under following conditions: Let us suppose we have a covering of strongly heated carbon on our grate, which we cover with a layer of green coal. This fresh coal is at once heated, and since each atom of carbon has an equal affinity for oxygen the carbon acts as a reducing agent to the CO_2 passing from heated carbon on grates, and reduces it to CO . If a supply of air is now given, the oxygen from the air will combine with CO and cause combustion to take place, the new compound passing off as CO_2 . It will be observed that CO differs from CO_2 inasmuch as CO is combustible while CO_2 is incombustible, and I may say another important difference is, that CO is very much lighter in specific gravity than air, and consequently easily escapes unconsumed to chimney.

Our great object as engineers is to get the greatest possible amount of heat out of the least possible quantity of coal. Every pound of coal we use, be it good, bad or indifferent, has a certain fixed calorific value as a heat-producing agent, past which we cannot go.

In boiler room practice and evaporation tests, all kinds of methods are adopted to arrive at the amount of what is termed "pure coal" burnt per lb. of water evaporated,—nearly all of

which are wide of any reliable results. Even in the highest practice it is a common thing to divide determination of elements in coal under four general headings, such as "moisture" "volatile substances" "carbon" and "ash." As a consequence of this very common error we often see the statement in print that the rate of evaporation per pound of pure carbon is so close to, or actually in excess of theoretical calorific value of this substance, that results are misleading and very often denied by well-informed engineers.

"Volatile substances" includes some very important elements for our purpose, and until we know what our "volatile substances" are composed of, and in what proportion, it is quite impossible for us to arrive at any reliable conclusion as to the calorific value of our fuel. As an instance, I might cite the highly important element hydrogen, which is contained in this class, and which has by far the highest calorific value of any of the constituent parts of our coal. The calorific value of hydrogen has been fixed at 62,000 heat units, or what is commonly termed British Thermal Units. A B. T. U. being, as, no doubt, your readers are aware, the amount of heat required to raise the temperature of one pound of water one degree Fahrenheit. Consequently one pound of hydrogen entering into combination with oxygen, as set forth in earlier articles on this subject, will form 9 lbs. of water and give off during the act of combination sufficient heat to raise the temperature of 62,000 pounds of water 1°F. , or, what is the same thing, evaporate 64 pounds of water from and at 212°F. under atmospheric pressure.

The calorific value of one pound of pure carbon has been fixed at 14,500 heat units, but this is subject to important chemical truths and conditions. This is the maximum calorific value of pure carbon, and to enable the engineer to secure this amount of heat he must have perfect combustion and completely form the chemical compound CO_2 .

The importance of our closely following natural laws during combustion of our fuel and the actual need of at least a rudimentary knowledge of chemistry can not be better illustrated than here, let us briefly review our general statements. 1st. Hydrogen is separated when coal is decomposed by heat. 2nd. It is a very light substance, and under proper conditions as to temperature, combines readily with oxygen. 3rd. Carbon combines readily at a given temperature with oxygen in one of two proportions. 4th. Both the elements, hydrogen and carbon, have a distinct calorific value as a fuel.

That hydrogen on combination with oxygen during act of combination gives off 62,000 heat units or evaporates 64 pounds of water from and at 212°F. , under atmospheric pressure.

Carbon combined with oxygen in proportion to form CO_2 gives off during act of combination 14,500 heat units, or will evaporate 15 pounds of water from and at 212°F.

Carbon combined with oxygen in proportion to form CO gives off during act of combination 4,350 heat units, or will evaporate but 4.5 pounds of water from and at 212°F.

CO combined with oxygen to form CO_2 gives off 4,750 heat units or will evaporate but 4.9 pounds of water from and at 212°F.

Every engineer can readily see the importance of having as nearly perfect combustion as possible, of carefully preserving the element hydrogen from escaping unconsumed, and the important fact that combination must take place within the furnace since heat is only given off at the actual time and moment of combination between the elements. It is also just as important that the air current be properly regulated since an excess of oxygen will simply pass into the chimney unchanged, and with the nitrogen absorb a certain quantity of the heat given off, and consequently reduce the evaporative efficiency of the fuel.

Other than the understanding of the chemical reactions constantly taking place within the furnace, a knowledge of chemistry is invaluable to us, since it enables us by means of analysis to readily determine the component parts of our fuel and its value as a fuel. In the sample in question, leaving out the unimportant elements, we are enabled to arrive at its calorific value. Since it consists of 85% carbon, and as each pound of carbon has a value of 14,500 B. T. U., we get 12,320 B. T. U. from this source, and from the hydrogen 3,100 B. T. U., or a total of 15,420 heat units equal to the evaporation of 15.9 pounds of water from and at 212°F. under atmospheric pressure per pound of fuel used. Knowing the actual value of our fuel, it then becomes an easy and simple matter for us to test and ascertain our actual evaporation and compare with the theoretical value of our fuel and see exactly what we are doing, and thus determine the cause of any loss or lack of fair economy.

I noticed the statement recently that a nation's greatness

depends upon the chemical knowledge of its people, and I think every engineer, who has closely studied his profession, will bear me out in saying that the greater our scientific knowledge the more valuable we become as engineers.

In conclusion, let me illustrate what an immense field for improvement lies ahead of us as engineers in this very question of securing the greatest possible efficiency per pound of coal burnt. I have said that each pound of coal has a defined calorific value and that each unit of heat has a definite value and duty. Heat is energy, and energy cannot be destroyed, and, as a consequence, every unit of heat has a certain defined mechanical value. It has been fixed that the mechanical equivalent or duty of an heat unit is the raising of 772 pounds 1 foot high, or what is the same thing, the raising of 1 pound 772 feet high.

Let us take, for an example, a 100-horse power plant using 180 pounds of coal per hour. This quantity of coal is equivalent to $2,775,600 \times 772 = 2,142,763,200$ foot pounds, being the mechanical value of heat generated from this quantity of coal per hour. This is equivalent to 1,078 h. p., and still in our most modern plants we are only able to obtain 100 h. p., or about 1/10 the actual value of the fuel. This is our best practice, and I venture to say that the average plant does not utilize more than 3% of actual value of fuel. I confess this is rather a startling statement to make, but a fact nevertheless.

CORRESPONDENCE

THE DUTY ON ELECTRICAL MACHINERY.

HAMILTON, ONT., Feb. 11, 1897.

To the Editor of the CANADIAN ELECTRICAL NEWS.

SIR,—In an article appearing in your February number entitled “The Duty on Electrical Machinery” written over the signature “Justice” several sweeping statements are made tending to decry the electrical industry in Canada.

Being directly interested in the design and manufacture of electrical apparatus, I would take exception to several of these statements as being wholly misleading.

The writer of the article starts out by saying that the electrical industry in Canada has no “raison d’etre” and yet a little further down states that we have “several very excellent colleges giving electrical courses and degrees.” Now I cannot see why the industry has no “right to be”; manufacture in this line to-day is based more on a matter of design and engineering and not on invention and research as in the early days of the art, and graduates of our colleges are supposed to be capable of designing a great part of the machinery as used in our lighting and power plants, and it is my candid belief that we have men in this country, many of whom working at nominal salaries in our various manufactories, who are in every way qualified to do a great deal in this line if they but had the confidence and support of our manufacturers and would further proclaim their capabilities without “fear and trembling.”

While I will admit that it would be useless, with our meagre experience and knowledge in this particular branch, to attempt to introduce heavy power transmission apparatus in competition with the highly developed apparatus of American design, yet there remains a great field for perfected constant potential and arc lighting devices, and for the classes of specialties which are always in demand, and because a few large alternators are imported there is no reason why the industry as a whole should be made to suffer in face of a tariff which would result in the flooding of the country with endless cheap apparatus.

There is of course no doubt that some of our Canadian made apparatus is not what it should be; as an instance we can cite the fact that there are not three firms in this country who make a modern and efficient constant potential motor or dynamo, but yet we have

not the slightest ground for an excuse for this state of affairs, as we have engineers capable of constructing modern apparatus if sufficient confidence were placed in their abilities instead of undervaluing same.

Being interested in the Thompson Electric Company I may state that the arc lighting apparatus of that firm is wholly of Canadian design in all its details, and designs are now being gotten out for open and enclosed arc lamps for either direct or alternating current circuits, which will enter the market in open competition with any imported or domestic article, both as regards efficiency and price.

The few articles entering into the construction of electrical machinery, which are of necessity now imported from the United States, would soon be furnished if the demand arose for sufficient quantities, and would it not be better to foster such industries, as well as retain the present ones, by guaranteeing sufficient protection, instead of doing the opposite by removing same?

Yours truly,

WM. A. TURBAYNE.

CLOSE REGULATION.

ST. MARYS, ONT., Feb. 22nd, 1897.

To the Editor of the CANADIAN ELECTRICAL NEWS.

SIR,—Will you allow me space in your valuable paper for the following, which may interest some of the electrical fraternity? I am in charge of an arc plant, and have 28 lamps direct current. The power is supplied by an 80 h. p. Corliss engine, non-condensing; average steam pressure 70 lbs. I have also a small incandescent dynamo, 30 lights, and a flax mill, with variable load. During a test the other night I let the steam vary 25 pounds on steam gauge, with the result that the voltmeter only varied one volt during the whole change of pressure. This I think remarkably close regulation in speed. I would like to hear through your paper the experience of other electricians on same line, and how close is the average variation in such a case.

Yours, Jos. H. WARD.

MOONLIGHT SCHEDULE FOR MARCH.

Day of Month.	Light.	Extinguish.	No. of Hours.
	H.M.	H.M.	H.M.
1.....	P. M. 6.10	A. M. 5.40	11.30
2.....	" 6.10	" 5.40	11.30
3.....	" 6.20	" 5.40	11.20
4.....	" 6.40	" 5.40	11.00
5.....	" 7.10	" 5.35	10.25
6.....	" 8.20	" 5.35	9.15
7.....	" 9.20	" 5.35	8.15
8.....	" 10.30	" 5.35	7.05
9.....	" 11.40	" 5.35	5.55
10.....	.....	" 5.35	4.55
11.....	A.M. 12.40	.....	.....
12.....	" 1.30	A. M. 5.30	4.00
13.....	" 2.20	" 5.30	3.10
14.....	" 3.00	" 4.30	2.30
15.....	No light.	No light.	....
16.....	No light.	No light.	....
17.....	No light.	No light.	....
18.....	No light.	No light.	....
19.....	P. M. 6.40	P. M. 9.20	2.40
20.....	" 6.40	" 9.20	2.40
21.....	" 6.40	" 10.50	4.10
22.....	" 6.40	" 12.00	5.20
23.....	" 6.50	A. M. 1.10	6.20
24.....	" 6.50	" 2.10	7.20
25.....	" 6.50	" 3.00	8.10
26.....	" 6.50	" 3.40	8.50
27.....	" 6.50	" 4.10	9.20
28.....	" 6.50	" 4.40	9.50
29.....	" 6.50	" 5.10	10.20
30.....	" 6.50	" 5.30	10.40
31.....	" 6.50	" 5.30	10.40

Total,

197.10

NEW ARC LIGHTING SYSTEM.

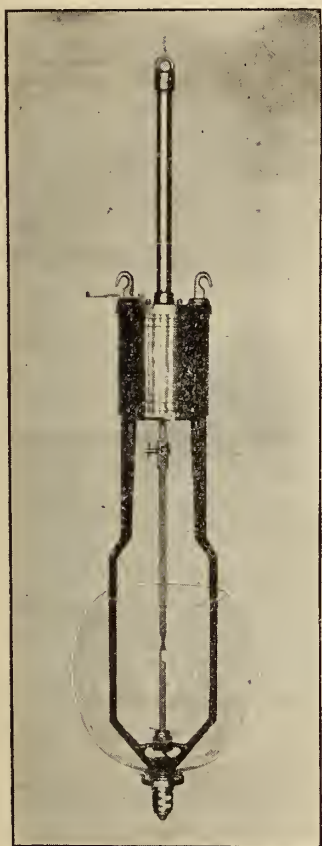
MANY of the arc lighting plants throughout Canada comprise in their electrical equipment dynamos which were designed some fifteen years ago, and which have not undergone since that period any radical changes of note, and arc lamps having birth about the same date, and which, although in some few cases they may have witnessed changes tending to cheapen the cost of manufacture, yet closely resemble the identical lamps of that period.

It is claimed that makers of arc apparatus have not made any pronounced digression from their original designs; they were too busy designing incandescent machines and perfecting the street railway, power, and the various alternating current systems of generating and translating devices, and as this work taxed to the utmost their staff of designers, and as the arc systems

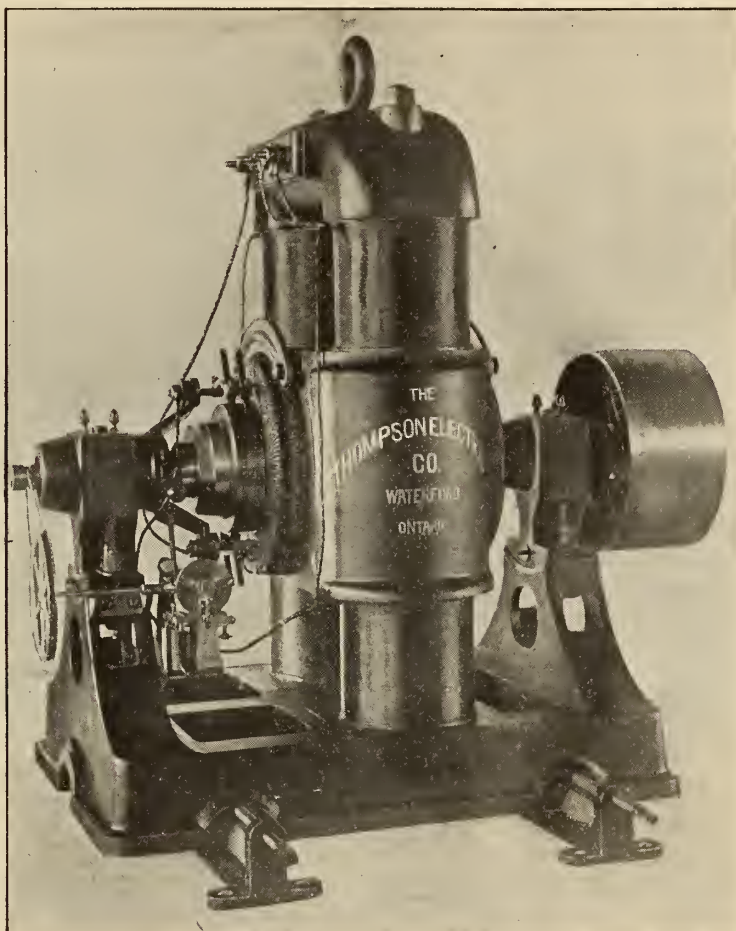
to the arc dynamos in use throughout the country to-day.

Arc lamps, and neat looking lamps at that, are now made by the same company, which are said to maintain a steady light through long periods of burning, and which are satisfied with a terminal voltage of 48 or 50 at the end of an all night run, and not 60 or 65 as heretofore. The gain is obvious; the dynamo is not compelled to furnish a constantly increasing E. M. F. in order to maintain arcs which lengthen as the shunt coils heat and carbons waste away, and the lamps burn at their most efficient wattage. This favorably affects the fuel pile.

The dynamo, the general outline of which may be noted by reference to the accompanying reproduction, possesses a number of valuable features. In the relative saturation of the field magnet and armature cores



ARC LAMP—THOMPSON ELECTRIC CO.



ARC DYNAMO—THOMPSON ELECTRIC CO.

of the day seemed to make light of some kind, and references to arc improvements were "pigeon-holed," and thereafter a long time remained.

Recently, however, a sort of arc lighting reaction has set in, and a demand has arisen for more efficient and serviceable apparatus, the older devices having been literally falling to pieces.

The Thompson Electric Company, formerly of Waterford, Ont., but now manufacturing in Hamilton, in order to meet this demand, prepared designs and constructed in detail a complete new system of arc lighting, including an automatic generator, lamps, and all station and outside accessories. They now offer a dynamo for which they claim some of the good features heretofore commonly associated only with constant potential machines, notably the suppression of sparking, a really genuine regulation, and a commercial efficiency largely over 50%, features which one cannot attribute generally

a wide departure from former practice has taken place, and the disposition and shaping of the pole-pieces have been so combined that as a result commutation is effected sparklessly throughout the entire range of the brushes, from full load to zero potential, and with but a single set of brushes having a constant width of lap. This calls for but one rocker-arm and greatly simplifies the regulating gearing.

The useful properties of a large armature reaction are employed in assisting regulation, and with the brushes in a fixed position several lamps may be switched on or off without greatly increasing or decreasing the current strength, although in practice the regulator immediately adjusts the brushes to a position of constant current value and of sparkless operation.

The manufacturers claim that the mechanical features of the machine, a substantial base, sliding rails for belt adjustment, self-centering pedestals with self-oiling and

aligning gun metal bearings, oil-gauges, and bored pole-pieces with a uniform width of air-gap, place it well beyond the criticisms of the operator.

The arc lamps, also illustrated, have been in use with eminently satisfactory results in a number of plants throughout the Dominion. They are substantially constructed mechanically and are correct electrically, and, in view of the greater number of lamps which are now placed on a single circuit, ample insulation is provided.

All parts of the mechanism perform their proper functions, both as regards feeding, cutting-out and re-lighting, on any current from 3 to 12 amperes, and the voltage across the arc remains practically constant throughout this range and during the entire period of burning, the feeding point remaining practically constant and the movements being imperceptible, resulting in a stable and unwavering arc.

In designing this lamp the greatest possible simplification, compatible with the most serviceable operation, has been the main object, and no complicated and frail devices are allowed to enter into its construction. The idea has been to abolish repairs and reduce operating expenses.

Current indicators, non inductive lightning arresters, and a complete line of improved station and outside accessories are embodied in this modern system of arc lighting. This system of apparatus is manufactured by the Thompson Electric Company, of Hamilton, under the designs of their electrical engineer, William A. Turbayne, and they will be glad at all times to furnish any information to any who may be interested in the matter.

THE AUBURN POWER COMPANY.

THE following particulars regarding the plant of the Auburn Power Company, at Peterboro', Ont., which has just been put in operation, have been kindly furnished by Mr. W. H. Meldrum, managing director of the company.

The plant is of the three-phase type, for power purposes only, furnished by the Canadian General Electric Company, and is A. P. 36-250-200 type, having 36 poles, and operates at 200 revolutions per minute, having a periodicity of 60 cycles per second, with a potential at full load of 2,000 volts. The machine and exciter are driven by two 66 in. "Boss" wheels, made by The Wm. Hamilton Manufacturing Co., of Peterboro'. The shafting, crown wheels and pinions, with eye beams, breach trees etc., were furnished by Messrs. Wm. & J. G. Greey, of Toronto, and the operating of the same reflects credit upon the manufacturers, there being some 18 tons of iron outside of the water wheels. The gear runs as smooth as a clock. The whole driving arrangement is carried on four steel girders, 6 x 14 in., bolted to six solid concrete piers. The water wheels operate under a 15 ft. head of water on the Auburn dam, and are tabled to 450 h. p., and being coupled together, the same shaft extending to the generator, which is 12 ft. in diameter and rests on a solid concrete bed. A large coupling bolts the armature of this large generator to the shaft, making a thoroughly rigid direct-coupled plant. The power plant is all in shape, and the big generator weighs some eighteen tons. It is the intention to supply power to all classes of manufacturers in Peterboro'. The company have a large surplus of water.

SPEED BY ELECTRICITY.

MR. W. J. Camp, of Montreal, writing in the Telegraph Age, says :

On page 467 of the last issue of the Telegraph Age appears an item from Electricity, London, suggesting the "use as a new unit of length for very great distances over which an electrical impulse could be sent in one second ; it is assumed that in one second a current impulse would travel seven times around the earth" (about 175,000 miles.) It may surprise many of your readers to be told that the speed of the electric impulse is very much less than is generally supposed. By actual experiment in Canada, between distant points, over No. 6 B.W.G. iron wire, without repeaters interposed, it was found that the speed was about 3-100 of a second per 1,000 miles, or 33,000 miles per second.

I might mention an experiment I tried last August. I made up a telegraph circuit from Montreal to Montreal (duplexed), with repeaters, as follows :—

	Miles.
Montreal	0
Sudbury	443
Fort William	998
Winnipeg	1,425
Swift Current	1,937
Donald	2,450
Vancouver	2,909
Portland	3,277
San Francisco	3,995
Albuquerque	5,195
Kansas City	6,011
Chicago	6,673
Toronto	7,315
Montreal	7,655

At McGill College, Montreal, a chronograph was connected and signals sent round the circuit, these signals being recorded when starting and also when completing the circuit. The average time occupied was .52 of a second for the 7,655 miles. I then connected the receiving side of one end to the sending side of the same end, so that a signal would be repeated back on the opposite side of the duplex, making a total circuit of 15,310 miles. The average time to complete the double circuit was 1.06 seconds.

Allowing 2-100 of a second for each of the twenty-six repeaters, this would make the speed only about 28,600 per second in the second case and about 29,400 in the first. The repeaters, of course, had to be estimated according to other tests, and the probability is that some of them occupied more time than others. Some of the repeaters were not well adjusted, as it was difficult to get the signals around the doubled circuit, a dash being reduced to a dot.

On a previous occasion the same circuit was arranged so that one end repeated into the other, and a signal started in one direction traversed the circuit eight times before it stopped. On another occasion a duplex circuit between Montreal and Vancouver, 2,909 miles, was connected at both ends, so that a signal went backward and forwards for over 200 times, and then only stopped on account of someone interrupting the circuit.

It is announced that acid in lubricating oil may be detected by putting the samples to be tested in a clear glass bottle, with a copper wire running down through the cork, air tight. Stand the bottle in a sunny place and let it remain for some days. If on removal verdigris or green rust is on the copper there is an acid in the oil. Such oil should not be used on machinery.

THE THREE-PHASE TRANSMISSION PLANT AT THE VALLEYFIELD MILLS.

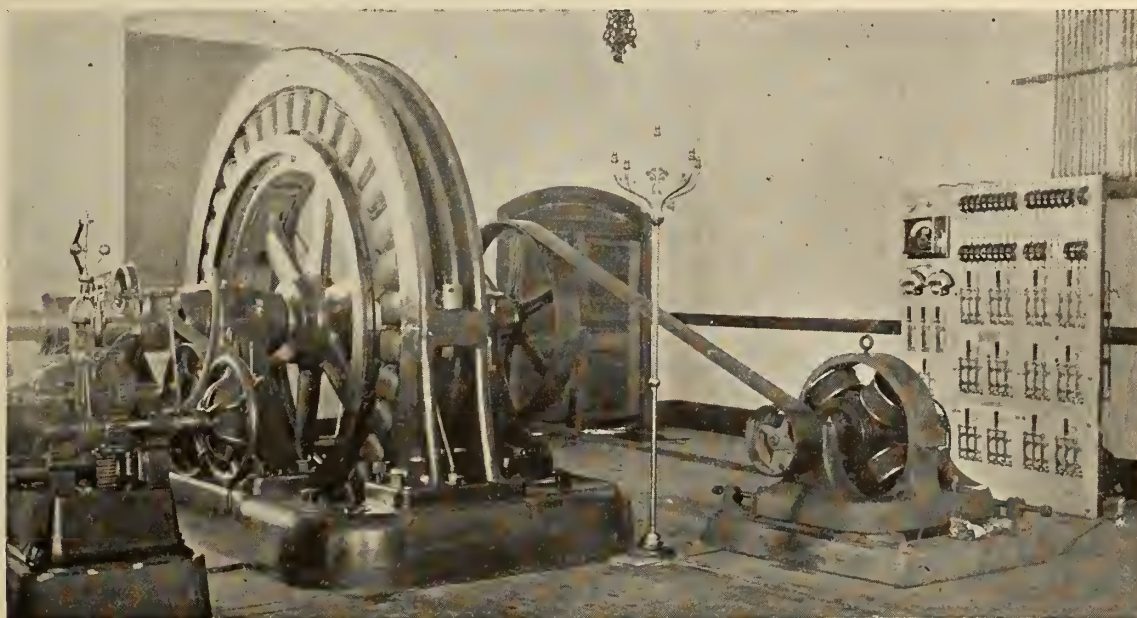
AMONG the most important of the great textile manufacturing establishments of the Dominion both in respect to the amount of capital invested and the value of the annual output are the mills of the Montreal Cotton Company at Valleyfield, P. Q.

At this point a dam erected by the Dominion Government to increase the depth of water in Lake St. Francis connects the Grande Isle de Beauharnois with the south shore of the St. Lawrence river creating incidentally an excellent water power. Upon this island, 23 years ago, the first mill of the company was built, containing 600 looms, the necessary carding and spinning equipment and a bleachery. About 16 years ago the mill was extended to contain 1,300 looms, and a dye house and finishing department were added to the bleachery. Three years ago the bleachery and dye-house departments were re-arranged and greatly enlarged and the mills have been enlarged each year since, until now they contain 80,000 spindles and 2,330 looms, and a bleach-

ery and dye-house large enough to handle 120 tons of cloth per week. The turbines are erected in pairs, each pair driving a 400 kilowatt generator. The lower part of the power house is all built in solid concrete, the power house proper above water, being built of stone, lined with terra cotta lumber. The roof is composed of 5" solid timber laid upon girders and covered with resin cement, and on the inside it is sheathed in steel, which is stamped out in panels and painted. Altogether the power house in solidity of construction and excellence of detail and finish is not excelled, if indeed it is equalled in America.

The wheels are governed by Replogle's new relay governors, the turbines being supplied by Mr. S. Morgan Smith, of York, Pa. The saddles and shafting were furnished by Wm. Kennedy & Sons, of Owen Sound, and by Mr. John McDougall, of Montreal. The gearing wheels were supplied by Mr. S. Morgan Smith.

For the electrical plant, as has been stated, the three-phase system of the Canadian General Electric Company



ELECTRIC TRANSMISSION PLANT AT VALLEYFIELD, QUE.

ery and dye-house large enough to handle 120 tons of cloth per week.

The large increase in the size of the plant during the past three or four years, combined with the lowness of water in the St. Lawrence, has rendered necessary an increase in the power plant of the company. This, up to last year, consisted of seven 60" and four 54" Hercules turbines and two 84" Risdon turbines.

The selection of electricity as the transmitting and distributing medium for the additional power plant was arrived at after a careful consideration of the first cost and losses involved in the various alternatives offered, of which the most feasible considering the comparatively short distance to which the power had to be carried, to the farthest point not more than 1,000 feet, was a rope transmission. The choice of electricity and of the three-phase system with induction motors was made after an investigation by the general manager of the company, Mr. Louis Simpson, of the principal plants operating under similar conditions in America, including the three-phase plants installed by the General Electric Company at the Pelzer and Columbia mills.

For the hydraulic portion of the new plant a new flume was excavated, which was arranged to contain

eight 60" McCormick turbines, each calculated to develop about 300 h. p., making a total of 2,400 h. p. The turbines are erected in pairs, each pair driving a 400 kilowatt generator. The lower part of the power house is all built in solid concrete, the power house proper above water, being built of stone, lined with terra cotta lumber. The roof is composed of 5" solid timber laid upon girders and covered with resin cement, and on the inside it is sheathed in steel, which is stamped out in panels and painted. Altogether the power house in solidity of construction and excellence of detail and finish is not excelled, if indeed it is equalled in America.

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For the electrical plant, as has been stated, the three-phase system of the Canadian General Electric Company

was adopted and a contract given to that company for two 400 kilowatt generators, the first of which has been installed and in satisfactory operation for about two months. The second machine will be in operation in the course of a few weeks. These generators, which are designated as A. P. 36-400-200 have 36 poles circumscribed within a steel yoke about the periphery of the revolving iron-clad armature and represent the latest development in design and construction for machines of this type. A point to be noted is the very slow armature speed, 200 revolutions per minute, which admits of direct coupling to the jack-shaft and of a consequent saving in power and floor space and a generally increased simplicity in the entire installation. The armature, which is of what is known as the A. P. type, is of the multi-tooth style of construction with distributed winding, and has, in consequence, a very low armature reaction with a correspondingly close inherent regulation. The generator voltage, on account of the short distance over which the power is to be transmitted, has been fixed at 550 volts, thus admitting of the current's being used directly on the motors at that pressure without the use of step-down transformers. The motors are of the C. G. E. Co.'s stand-

ard induction type varying in size from 50 to 100 h.p. and are, where a saving in floor-space is desirable, of the inverted type, bolted to the ceiling. They are, of course, self-starting under full load, and as they are without collector rings or brushes, are especially suited for operation under the conditions favorable to combustion which exist in a cotton mill.

Altogether, the plant is a model one in every respect, and as the successful outcome of the first attempt on a large scale in Canada to secure increased economy by the use of electric power in the operation of a large industrial establishment reflects the highest credit on Mr. Louis Simpson, the able and energetic general manager of the Cotton Company, and his foreman mechanic, Mr. Jas. Sparrow.

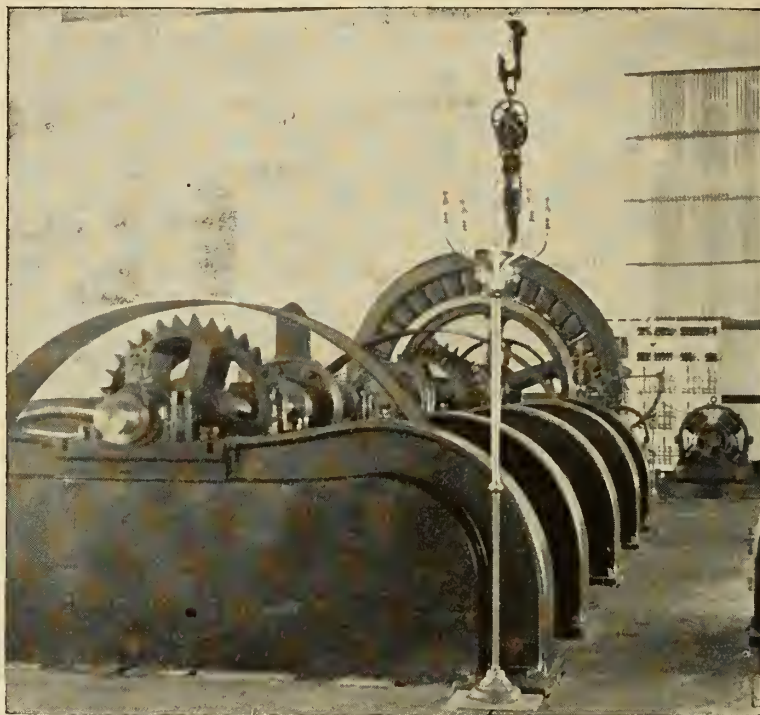
It might be added that the Montreal Cotton Company have now, as a result of the extension of their plant, a surplus of about 1,500 horse-power which they would be prepared to dispose of for manufacturing purposes, on a most liberal basis. The excellent situation and shipping facilities of Valleyfield should, under these circumstances, make it a particularly desirable manufacturing site.

PERSONAL.

Mr. F. L. Walmsby, an electrician in the employ of the Toronto Street Railway Company, died last month. He was born in Davisville 36 years ago.

Mr. W. H. Breithaupt has been elected president of the Berlin and Waterloo Street Railway Company, to succeed the late E. Carl Breithaupt. Mr. Harry Aldrich has been appointed electrician for the electric plant.

At the recent meeting of the Executive Committee of the Canadian Electrical Association the secretary was instructed to convey



ELECTRIC TRANSMISSION PLANT AT VALLEYFIELD, QUE.

the last two years has had charge of the arc lamp department of the company.

SPARKS.

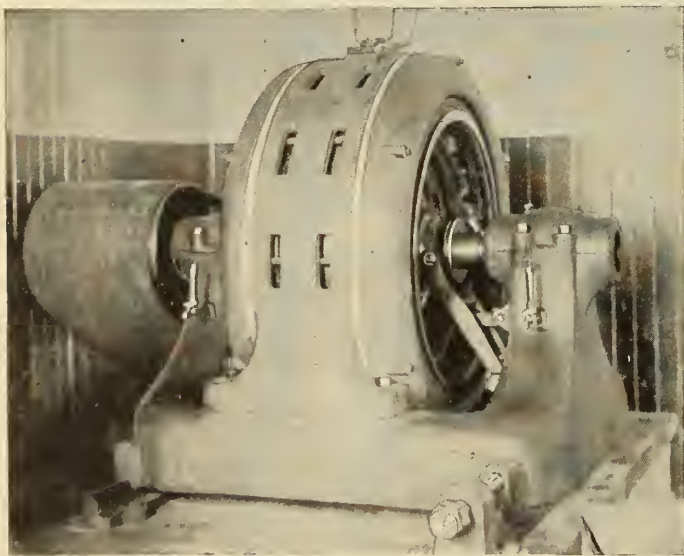
Graham & Peckles, electricians, have commenced business at Halifax, N. S.

The annual statement of the Bear River, N. S., Electric Light Company showed the earnings for the year to be \$1,244.80, and the net expense \$661.30. Over seventy lights were added during the year.

The town of St. Mary's is extending its new electric light plant to 31 lamps. It is said to be giving thorough satisfaction at a cost of about 400 dollars less than the old system, and they now have 3 times the candle power.

The Hamilton Electric Light Company recently held their annual meeting, president Robert Thomson being in the chair. The statements presented by the secretary-treasurer were satisfactory, and the following directors and officers were re-elected. Robert Thomson, president; John Knox, vice-president; J. V. Teetzel, Q.C., secretary-treasurer; Robert Evans, Alex. Turner, J. J. Wright, S. F. McKinnon, H. M. Pellatt, Toronto. Gordon G. Henderson was reappointed manager, and C. S. Scott auditor. The president tendered a dinner to the directors and friends in the evening.

The annual meeting of the Toronto Electric Light Company was held on the 2nd of February. The report of the directors stated that the business done had shown a steady increase, and the earning capacity had been maintained, notwithstanding the decrease in revenue caused by a reduction in the price of light. The income for the past year for lighting, power, rent, etc., was \$265,897.46, while the expenses were \$172,234.69, leaving a balance of profit of \$93,762.77, out of which four quarterly dividends were paid at the rate of 7 per cent. per annum, amounting to \$75,119.94, leaving a balance of \$18,642.83 to carry forward. The old Board of Directors was elected as follows:—H. M. Pellatt, President; W. D. Matthews, Vice-President; A. H. Campbell, S. F. McKinnon, Hugh Blain, W. F. Murray, Hon. George A. Cox, Robert Jaffray, W. R. Brock, Samuel Trees, Thomas Walmsley, H. P. Dwight, Frederic Nicholls and Hugh Ryan.



ELECTRIC TRANSMISSION PLANT AT VALLEYFIELD, QUE.

an expression of the sympathy of the members of the Association to the relatives of the late Mr. E. Carl Breithaupt.

Mr. A. A. Knudson, electrical engineer, who is well known in the maritime provinces as the moving spirit of the electrical exhibition held some years ago in St. John, N. B., has recently entered into partnership with F. E. Knudson at 66 Broadway, New York. The firm will act as consulting and supervising electrical engineers.

The Welland Power and Supply Canal Company will apply to Parliament for authority to extend the time for commencing their proposed works.

MANUFACTURE OF THE INCANDESCENT LAMP.*

BY HARRY BRECK.

THE incandescent lamp, as we see it, is made in two distinct parts. First I will describe the globe. The globe, as it is delivered from the glass works, comes in the form of a florence flash, as shown in Fig. 1.; this is heated and a cone drawn out at the part x (Fig. 1.) To this portion is placed a piece of glass tube shaped as in Fig. 2. The reason for the narrow portions (marked a Fig. 2,) I will explain later.

The next operation is to make the base for the filament. A glass tube is taken and a portion of it near the end is thickened, as in Fig. 3. This afterwards fits into and is fused into the neck of the globe (marked a Fig. 1). Two platinum wires are then put in this tube and the end (marked x Fig. 4) is heated and the two wires are thus imbedded in the glass. Care is taken that these two platinum wires do not come in contact with one another. These wires are bent, as shown in Fig. 4, in the shape of an L. To these terminals are afterwards fused the ends of the filament.

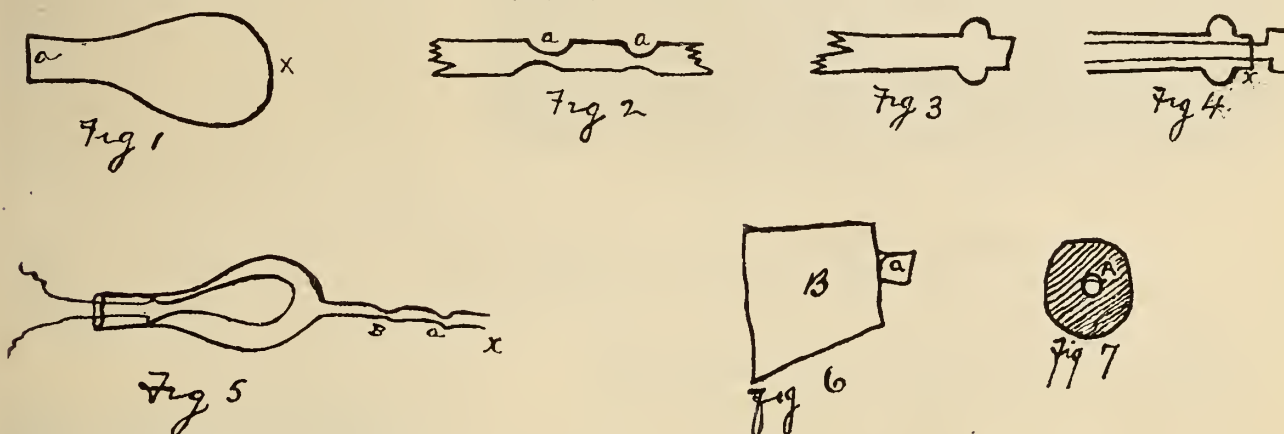
After the filament (the manufacture of which I will speak of next) is fastened on by an electro deposit of copper to these platinum wires, the base (Fig. 4) is

moulds are of nickel, and in them are cut grooves of horse-shoe shape. A flat nickel plate is placed over them, and the whole is placed in an oven and heated to an immense heat, so the bamboo becomes completely carbonized. The filaments are then fastened to the platinum points in the manner already described.

You ask, "what about the gas in the fibres of the carbon filament; how do you get rid of it?" This is the method: When the lamp is being exhausted a current of electricity is sent through the lamp (this is set on when the lamp is very nearly exhausted) and any air or gas contained in the filament is expelled and passed out while the air is being exhausted. In a 16 c.p. lamp the current used would raise the lamp to a 32 c.p., and so you see only the fittest survive. It can be known when the gas is all driven out by the disappearance of the violet blue color surrounding the filament.

All that now remains to be done is to fasten the lamp to the base. The method of doing this is shown in Figs. 6 and 7. Two pieces of brass "a" and "b" (Fig. 6) are kept separated by a porcelain disc (see end view Fig. 7), the shaded portion showing the porcelain.

The shell b (Fig. 6) is made of thin sheet brass, and the part a (Fig. 6) is a brass rod about $1\frac{1}{2}$ " long and about $\frac{3}{8}$ " in diameter. These make the connections in



fused into the neck of the bulb (Fig. 1 marked at a); it then appears as in Fig. 5. The end of the tube, marked x, is then connected to an air pump, and the vacuum procured. The end "a" is then fused, afterwards B, and the lamp is complete ready to be connected to the brass vase. The reason for the two sealings is to avoid all possibility of air escaping into the globe, a second sealing renders this impossible; and the reason that platinum wire is used is that it expands and contracts with heat almost the same as glass.

Now for the construction of the filament. This filament is NOT wire, as a great many suppose; it is practically the same substance we burn in our arc lamps, namely, carbon. This filament is made of carbonized bamboo. The carbon is taken and split several times, lengthwise, all the hard silicious outer covering removed, and the remaining straight fibrous portion is shaved down until it is of uniform thickness, and then cut to the required length. These are taken and pressed between two metal blocks which are accurately surfaced to each other. The projecting pieces of bamboo are cut away, except a small portion at each extremity. This leaves a fine strip of bamboo, with an enlarged portion at each end. These strips are then placed in moulds (the chief form being the horse-shoe shape of filament) of the shape required for the filament. These

the socket. One wire of the lamp is soldered into this brass rod (a Fig. 6), the other into the brass shell (b Fig. 6). The lamp is fastened into this with plaster of Paris. This completes the process of manufacture of the incandescent lamp.

IN MEMORIAM.

SINCE the date of our last issue we have received from members of the Canadian Electrical Association and others many sympathetic references to the death of the late Mr. E. Carl Breithaupt. Among these are the following lines from Mr. D. H. Keeley, of Ottawa:

TO THE MEMORY OF E. CARL BREITHAUP, VICE-PRESIDENT OF THE CANADIAN ELECTRICAL ASSOCIATION.

A light gone out! Alas, a light gone out?—
Whose full bright radiance, while it lasted,
Oft times gave courage when lethargic doubt
Sat 'pon th' hoped emprise of one exhausted.

Brilliant the mind 'twas his to bring to bear
On all occasions affecting what we did;
He bore in all our aims a gen'rous share,
E'er helped investigate what's to us hid!

Miss him we will—alas, the light that's gone!—
In all our growth of practice; in our convention halls:
Where'er obtains the need for brain and brawn—
Th' qual'ties outpushing our inhemming walls.

O he who shone so brightly in our sphere—
Who strove to make our onward way the fleetest—
Has left behind with us a memory dear,
Of pure devotion; of himself, a sweeter!

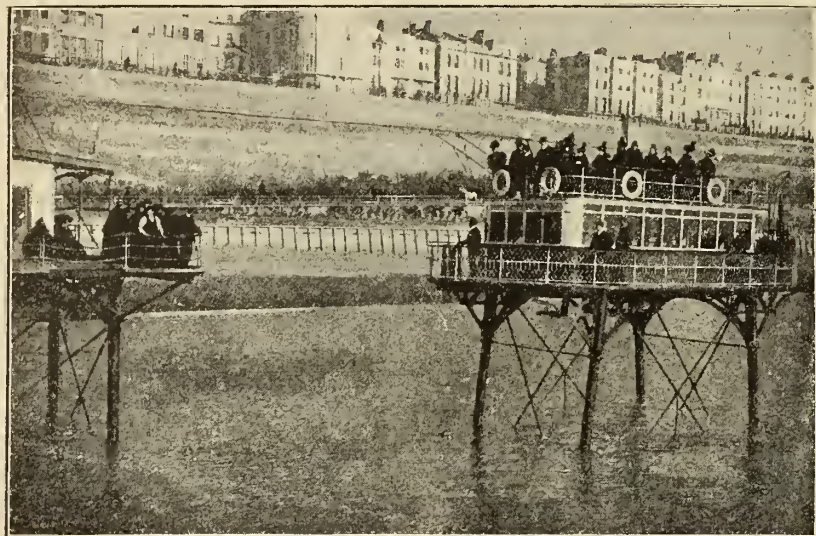
—A FELLOW MEMBER.

*Paper read before the Kingston Association of Stationary Engineers.

ELECTRIC RAILWAY DEPARTMENT.

A SEA-SHORE ELECTRIC RAILWAY.

AN electric railway which has lately been put in successful operation between Brighton and Rottingdean, England, is one of the most novel systems which has yet come under our notice. The promoter operated a small sea shore tramway at Brighton, which he desired to extend to Rottingdean, a distance of four miles. The steep cliffs along the route made it necessary to



CAR LEAVING PIER.

follow the foreshore, which was covered almost constantly with water, and at a point slightly above low water mark, but some fourteen feet below the sea at high water, the track was constructed.

It was proposed to run the cars at all times irrespective of the tide, which necessitated the building of a car of special design. It was made of a half boat and half car, mounted on four long legs, at the end of which are the wheels which run on the track. The car has 16 wheels, each leg of the car being mounted on a four-wheel bogie, and the wheels of the bogie run on the narrow gauge line. The bogie trucks are shaped like a double-ended boat to facilitate passage through the water as well as to remove obstructions from the lines. The four bogies are held together by steel tubular struts, and the wheel base is about 28 feet. The top of the main legs carry lattice girder work, on which the main deck is erected, the whole structure being braced together by means of cross ties. The main deck is 50 feet in length and 22 feet in width, surrounded by iron railings, provided with wire netting. There is also a saloon in the centre, with a second deck on top, and altogether the car will carry two hundred passengers.

The track consists of four rails, 54 pounds to the yard, the distance between the two outer rails being 18

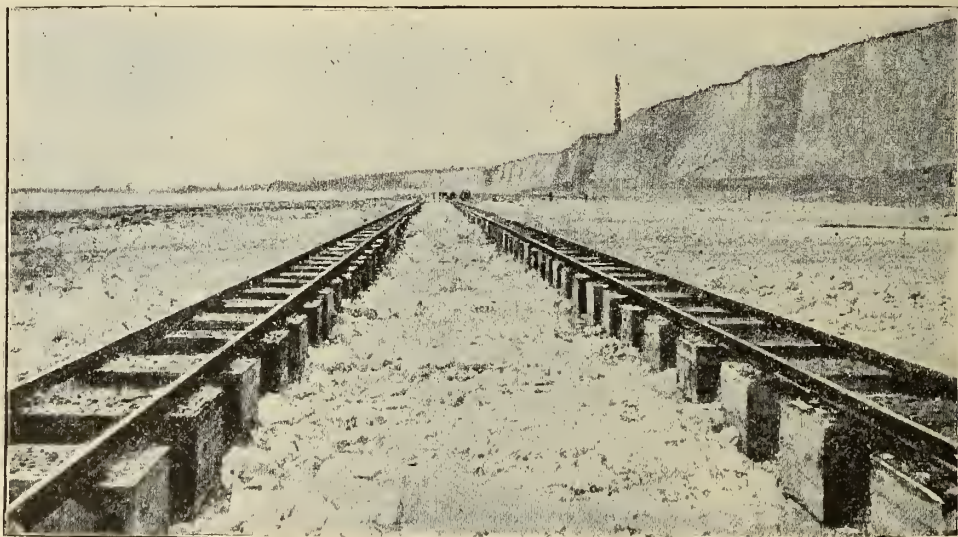
feet, which will give an idea of the width of the car. Much difficulty was encountered in laying the track, as work could only be carried on when the tide was low. The rails are fastened to concrete blocks, placed every few yards by means of steel clips and bolts, the latter passing through oak blocks placed between the rails and the concrete. Tie rods are used every ten feet on the straight and every five feet on the curves, heavy angle fish plates being used for the rail joints. The accompanying illustrations will enable our readers to a better understanding of the system.

The cars are propelled by means of overhead trolley wires of a special type, and on the cars are two 30 h.p. motors of the C. G. E. 800 type, placed vertically over two of the main legs, the armature being connected through bevel gearing to a vertical shaft geared to the axles of the wheels. The controlling devices are located at each end of the deck, and the brakes are operated by rods passing down the two unoccupied legs. The generating plant consisting of a four-pole railway generator direct-connected to a high-speed double-acting engine, is located at

the Rottingdean end of the line. The machinery, however, is not of a sufficiently novel design to warrant a description. The total cost of the road is estimated at \$150,000, this sum including the construction offices at each end.

MR. H. J. SOMERSET.

Mr. H. J. Somerset has been appointed to the posi-



VIEW OF TRACK AT LOW WATER.

tion of Superintendent of the Winnipeg Electric Street Railway, to fill the vacancy caused by the retirement of Mr. G. H. Campbell, as manager.

For the last three years Mr. Somerset has held the position of electrician for the company, so that his appointment comes by way of promotion.

He received his professional training at the Worcester (Mass.) Polytechnic Institute, from which he gradu-

ated in 1891, with the degree of B. Sc. in Mechanical Engineering. Previous to his attendance at the Polytechnic Institute he spent two years in practical work in steam engineering and machine shop practice with the Canadian Pacific Railway.

After graduation he devoted himself for a like period to electrical work as applied to street railway operation at the Canadian General Electric Company's works at Peterboro', and on the Toronto Railway.

Mr. Somerset brings into his new sphere of duty a thorough knowledge of every department of street railway work, and an ambition to make a record for himself which augurs well for his success.

SPARKS.

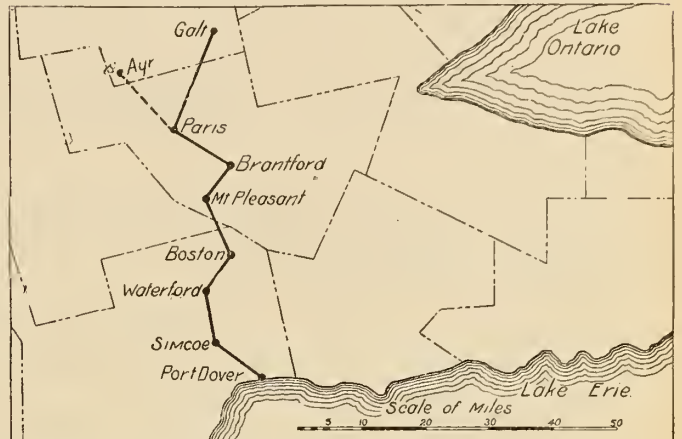
The Central Counties Railway Company propose extending their line and adopting electricity as the motive power.

Several changes have taken place in the staff of the London street railway. Mr. L. DeHart, superintendent, has retired, and is replaced by Mr. S. Potter. Mr. L. Robinson, assistant superintendent, has been promoted to the superintendency of the Montreal Park and Island Railway, and is succeeded by Mr. John Break.

A conference was held between some prominent citizens of St. Catharines and the managers of the Hamilton, Grimsby and Beamsville railway, for the purpose of considering the extension of the railway from Beamsville to St. Catharines. Owing to engineering difficulties and the expense of construction, it is not probable that the work will be carried out by the company. The statement has been made, nevertheless, that Hamilton capitalists are prepared to build the proposed line, provided power can be obtained from DeCew Falls.

BRANTFORD, PORT DOVER AND GALT ELECTRIC RAILWAY.

A COMPANY has been organized at Brantford, Ont., Mayor Elliott being one of the promoters, to construct an electric railway south from Brantford to Port Dover,



on Lake Erie, via Mount Pleasant, Boston, Waterford and Simcoe, a distance of about 40 miles. A northern branch will extend to either Galt or Ayr, about 30 miles distant, making a line 70 miles in length. The road will carry passengers and light freight, and will extend through a rich agricultural country and connect a number of small towns. The accompanying map showing the line is reproduced from the Street Railway Review.

The street railway company at Port Arthur, Ont., are considering the question of putting in a plant for lighting purposes.

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SPARKS.

The London Street Railway Company have commenced work on double-tracking the remaining portion of the line to Springbank.

The Ottawa River Navigation Company, which controls the Carillon and Grenville railway, a line 13 miles in length, propose to convert the road into an electric system at an early date.

The South Essex Electric Railway Company are applying to the Ontario Legislature for power to build an electric railway from Windsor to Sandwich, thence to Amherstburg, Kingsville and Leamington.

The Desbarats & Northern Railway Company is seeking incorporation to build a steam or electric railway from St. Joseph's Island, Algoma, to a point near Desbarats Station, thence to Moose Factory, on James Bay.

Several gentlemen interested in the Ottawa street railway visited Montreal and paid a visit to Sohmer Park. It is proposed to run a similar park at the West End Park, Ottawa, where a large pavilion will be erected.

Messrs. J. J. Franklin, of Toronto, and George C. Rankin, of Detroit, are said to be at the head of the syndicate which proposes to build the Chatham City and Suburban Electric Railway. The council will be asked to extend the franchise to include electric lighting.

At the annual meeting of the shareholders of the Quebec Street Railway Company, held on the 2nd ultimo, directors were elected for the ensuing year as follows: Messrs. G. R. Renfrew, G. LeMoine, F. Tessier, D. C. Thomson, J. C. Thomson, S. J. Shaw, E. H. Taylor. At a subsequent meeting of the directors Gaspard LeMoine was elected president and G. R. Renfrew vice-president.

Incorporation is asked for the Ingersoll Radial Electric Railway Company, for the purpose of constructing an electric railway from Ingersoll to St. Marys, through the villages of Thamesford and Kintore, with branch lines to Tilsonburg and Brownsville. The capital stock is placed at \$500,000, and bonding powers to the extent of \$10,000 a mile are asked. Operations are to be commenced within two years.

It is reported that among the other attractive novelties which the Hull Electric Railway Company intend introducing next summer will be an electric water route between their proposed new hotel at Aylmer and their park at Point aux Pins. Piers will be sunk a short distance from shore to hold the poles for the support of the overhead wire, and a flat-bottomed boat with

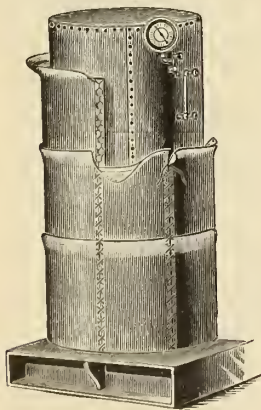
trolley will convey passengers to and from the park along the margin of the lake.

A bill to incorporate a new tramway and electric company has been introduced a few days ago. The new company propose to run cars to Bedford, through Rockingham, a distance of 8 miles, also to have the privilege of supplying electric light and power for manufacturing purposes; capital stock \$300,000. Among the promoters are Messrs. E. Crowe, H. J. Crowe and A. E. Sulis, and the work is to be completed in three years.

The Fort Erie Electric Railway will apply to Parliament to increase the capital stock to an amount not exceeding \$250,000; also to authorize the company to extend its railway from its terminus in the village of Fort Erie to Chippewa, through the villages of Fort Erie and Bridgeburg, for the purpose of constructing and operating a street railway within the limits of said villages. It is also proposed to construct a branch line from the main line of said railway north to the village of Ridgeway.

There has been for a considerable time disagreement between the Toronto City Council and the Street Railway Company as to the mode of determining the length of track on which the mileage should be paid. The city holds that curves, crossings and the like should be measured. The company, on the other hand, refuses to pay for the curves and crossings. As a result of this disagreement, the City Solicitor has entered an action against the Toronto Railway for \$23,870 arrears of mileage, for a construction of paragraph fifteen of the franchise under which the mileage is paid and for a declaration that the city is entitled to \$17,055 per quarter instead of \$15,000, the amount now paid. The total amount involved during the term of the franchise is almost a quarter of a million. The suit will be brought to trial as soon as possible.

A dispatch from Niagara Falls, Ont., states that a deal has been consummated by which Alderman George Hanan and Mr. Edward Davis secure control of the Niagara Falls, Clifton and Drummondville street railway, a line three miles in length, extending from Niagara Falls, Ont., to Drummondville, now Niagara Falls South. The road is now operated by horses, and was controlled by New York parties, who held a nine years' franchise. It is understood that a Toronto syndicate were the purchasers, and that an additional extension of their franchise for ten years will be asked from the Councils of Niagara Falls and Niagara Falls South. It is probable that during the present year the motive power of the road will be changed to electricity, while among other improvements in view is the extension of the line to Fort Erie, opposite Buffalo, to connect possibly with some of the electric lines running out of Hamilton. Mr. George Hanan has superseded Mr. Black as manager.



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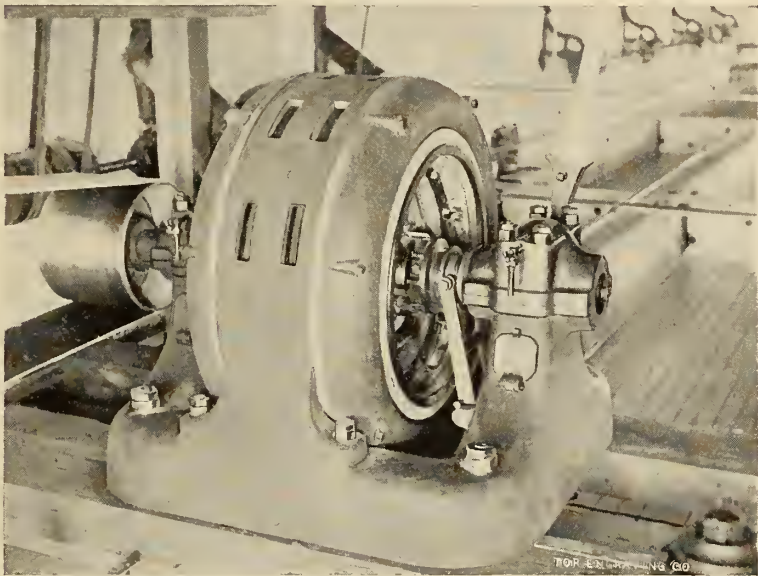
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SPARKS.

A proposal to light Huntingdon, Que., by electricity is being considered.

Shubenacadie, N. S., proposes to have its streets lighted with electric lights.

The Moncton Manufacturing Co., of Woodstock, N. B., is seeking incorporation, to manufacture engines, etc.

A syndicate is said to be making arrangements for operating a cable car system at Rossland, B. C.

The British Columbia Electrical Construction Co., of Vancouver, B. C., has been dissolved. W. Brown continues.

The Reid Bros. Manufacturing Company, Toronto, manufacturers of bent iron pulleys, have gone into voluntary liquidation.

The City of Quebec have renewed the contract for street lighting for five years with the Montmorency Electric Power Company.

The foundation for the new electric light and power plant at Trail, B. C., is completed, and the dynamos and other machinery are being placed in position.

The annual meeting of the shareholders of the Canadian General Electric Company was held in Toronto on February 8th. The report for the year 1896 showed assets amounting to \$1,213,963.41. The directors were re-elected as follows: President, W. R. Brock; Vice-President, H. P. Dwight; Second Vice-President and Managing Director, Fred. Nicholls; Board of Directors, Hon. Geo. A. Cox, Robt. Jaffray, J. K. Kerr, W. D. Matthews and Hugh Ryan.

The seventeenth annual report of Mr. E. O. Champagne, boiler inspector of Montreal, shows that during the year he made 1,720 visits and conducted 706 examinations of boilers, submitted 430 to hydraulic pressure and 44 to hydrostatic proof. Ten were entirely condemned and 129 declared defective. Fifty new boilers were installed and inspected. The inspector issued 317 notices and 474 certificates of inspection, and issued 516 certificates to mechanics.

The annual report of Mr. P. Bowler, city electrician, New Westminster, B. C., states that the number of incandescent lamps in use in 1896 was 4,481, an increase of 1,555 during the year. The report recommends the extension of the system, at an estimated cost of \$3,500. The present staff of the electric power house is one electrician, two engineers, two firemen, two trimmers, one lineman and one dynamo tender. The cost of street lighting is placed at the same figure as the year before, viz., 35 cents per light per night.

Mr. Joseph Cozens, the original promoter of the proposed Sault Ste. Marie and Hudson Bay Railway, who took the first steps towards obtaining a charter for the road in 1889, advocates the adoption of electricity as the motive power. In a recent paper read before the Ontario Land Surveyors, he says: "Concerning the railway itself, I trust it will be the first electric through line on the continent. The water powers on the route will furnish more than sufficient power, and that electricity will be used for railways of the future is beyond question."

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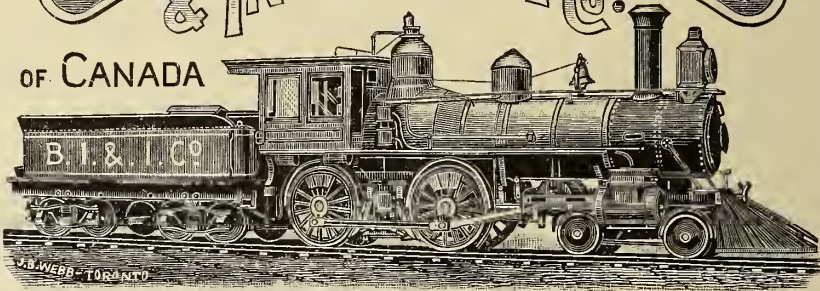


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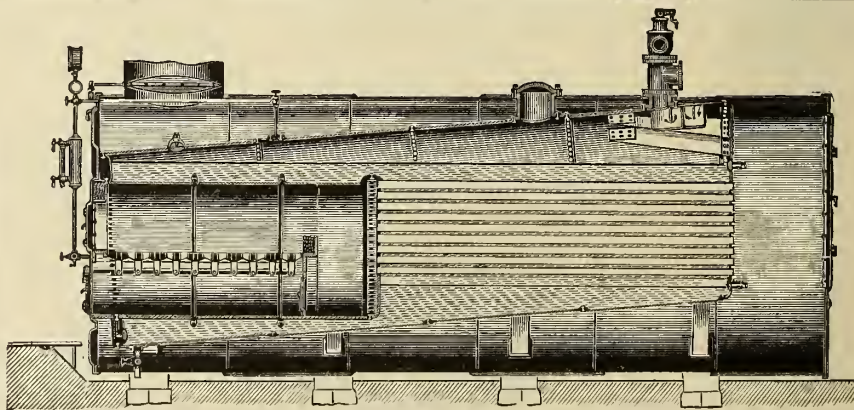
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NEW SERIES, VOL. VII.—No. 4.

APRIL, 1897

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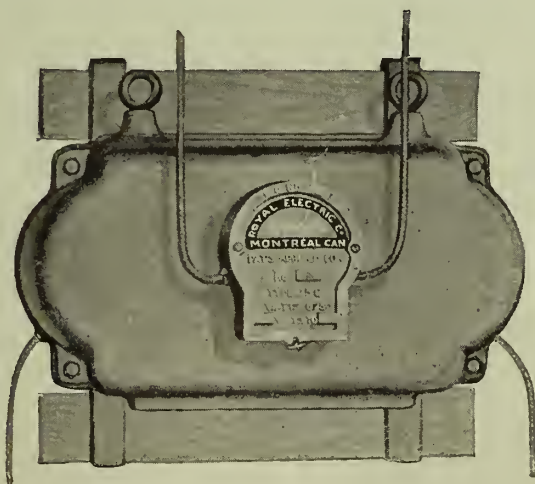
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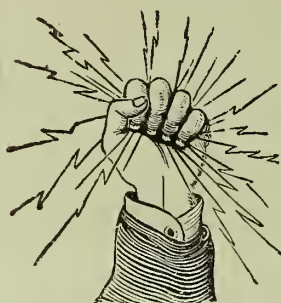
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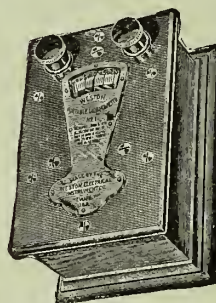
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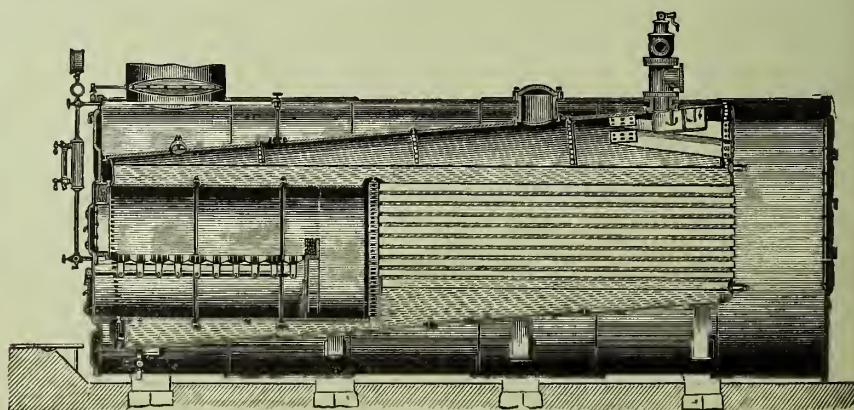


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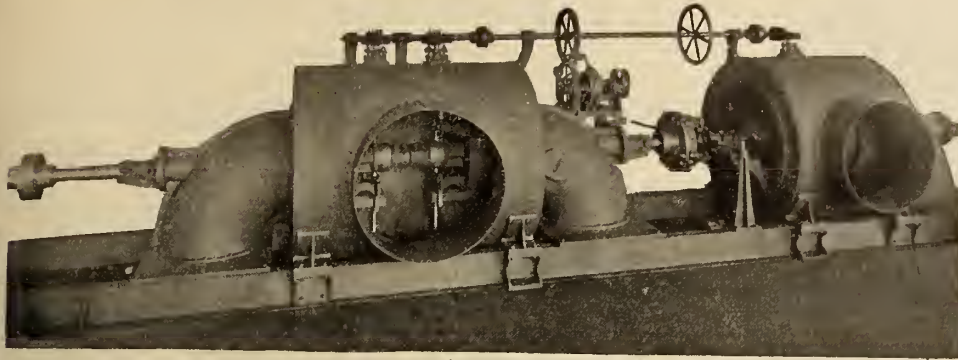
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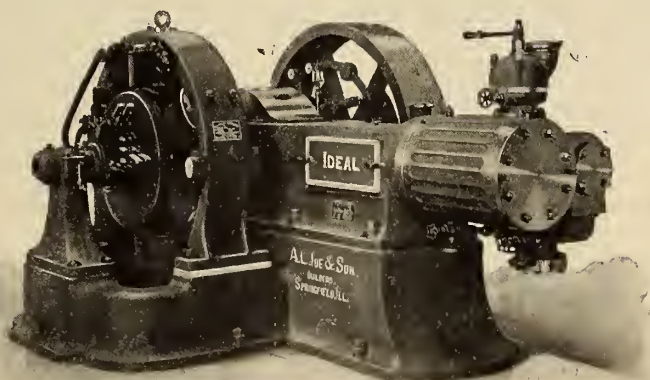
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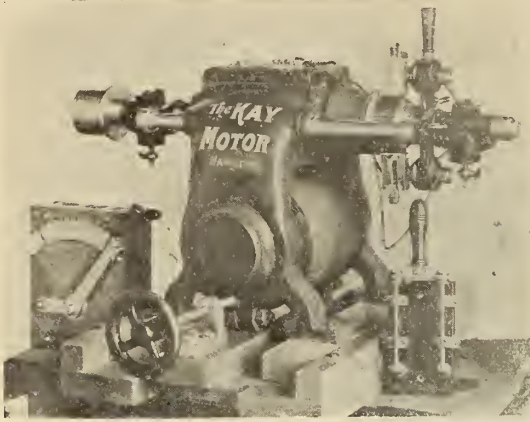
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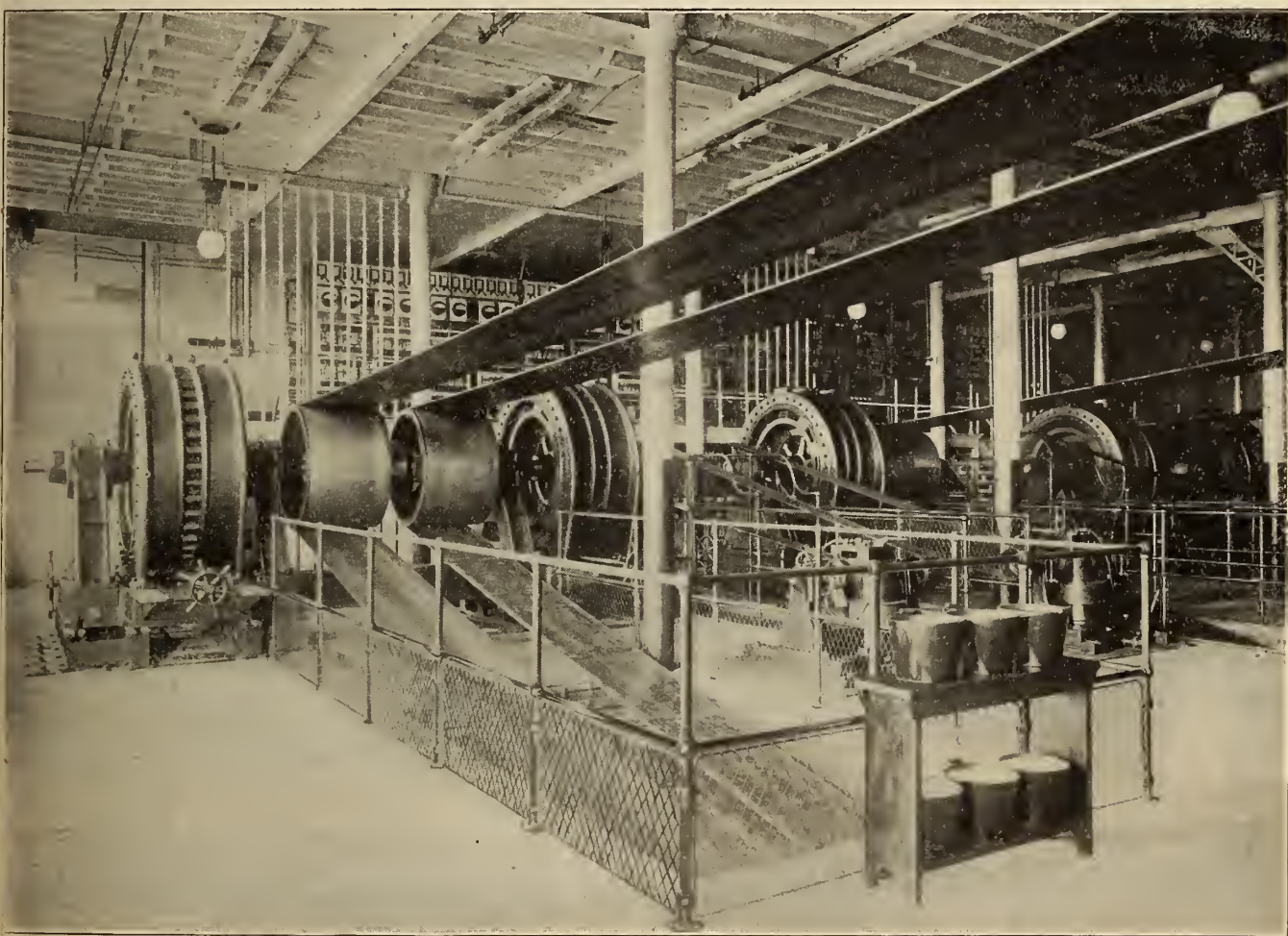
**RECONSTRUCTION OF THE ALTERNATING
CURRENT SYSTEM OF THE ROYAL ELEC-
TRIC COMPANY, MONTREAL, CANADA.**

By P. G. GOSSLER.

To meet the generally increasing demand for light and power supplied from central stations, it has, in many instances, been necessary to erect new generating stations, or to reconstruct the existing plant, discarding the old inefficient apparatus and substituting therefor equipment of modern design. In some of the larger

conditions. Besides, there is generally a multiplicity and variety of apparatus, the operation of which is accompanied with danger and unsatisfactory service.

The necessity of giving satisfactory and uniform service, of reducing the cost of operation, and of meeting the increasing demands for light and power being recognized, and the conditions being such as to permit of meeting these requirements, an investigation of the existing conditions generally results in the adopting of one of two plans: First, the building of a new generat-



S. K. C. GENERATORS, ROYAL ELECTRIC COMPANY'S ALTERNATING CURRENT LIGHTING STATION, MONTREAL.

cities this fact has apparently been appreciated for some time, as there have been erected stations which are magnificent examples of modern generating plants, operating with the highest economy obtainable at the present time and giving evidence in their design of the highest engineering skill.

Many generating stations at present supplying a large output have attained their growth gradually, having from time to time installed additional apparatus as it was required by an increasing business and extension of territory supplied. These stations are now confronted by figures and results showing their cost of operation per unit of output to be much more than it should be, or would if the same output was produced by more efficient apparatus operating under modern

ing station and equipping it with modern apparatus, utilizing the old plant for continuing the service during the course of the construction of the new one, and possibly retaining it afterwards as spare capacity, or secondly, to reconstruct or re-equip the existing plant to conform to the aforementioned requirements.

The latter plan of reconstruction will, without doubt, be decided upon in the majority of cases, as the use of large units permits of the installation of sufficient capacity, in the same space occupied by the old apparatus, to meet future demands for a reasonable length of time.

There have been numerous descriptions published giving examples of plants erected to replace those found to be inefficient and giving unsatisfactory service. It is to be noted that, so far, these new plants, with but few

exceptions, are direct current stations serving light and power to congested districts and comparatively small areas. This account is of the reconstruction of an alternating current system supplying current to a large territory.

The history of the Royal Electric Company of Montreal, and the growth of its lighting and power plants

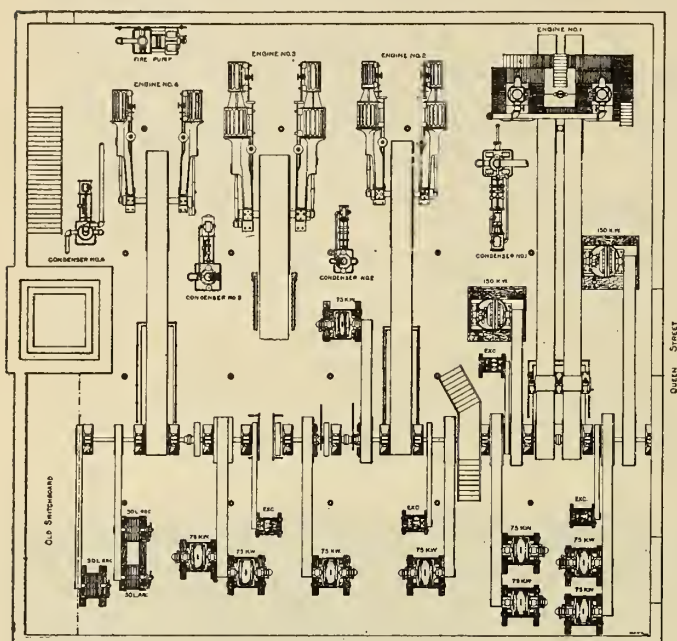


DIAGRAM NO. 1.

from a 12 light arc machine in 1884 to the present time of serving about 65,000 incandescent lamps, 1750 arc lamps and 750 h. p. in motors has been told in previous issues of electrical journals.

Early in 1896 the directors of the company, upon the recommendation of the general manager, Mr. W. H. Browne, authorized the entire reconstruction of its alternating current station and lines—this reconstruction to be carried out upon plans which should adapt the system to be served either with power from its existing steam plant or from the water power plant at Chambly, which is at present being rapidly developed.

The foresight shown in the recommendation and authorization of this wholesale reconstruction and re-equipment has been well established by results already

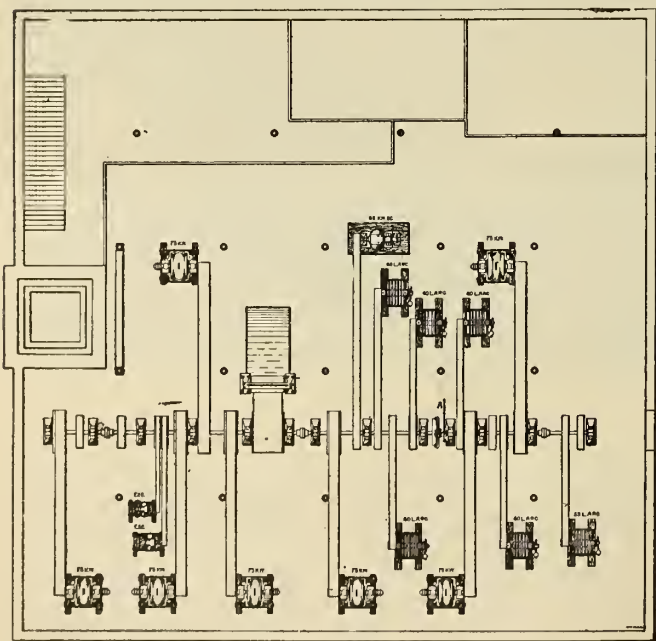


DIAGRAM NO. 2.

obtained. The economy of replacing inefficient apparatus by apparatus which is the production of the highest grade of engineering is, in this instance, no longer a possibility but an established fact.

One of the generating stations of the R. E. Co. is devoted exclusively to supplying direct current arc service.

The equipment of the second or Queen street station, for serving light from an alternating system, with a spare series arc capacity, prior to its reconstruction, consisted of 18 alternators, 6 exciters and 9 arc machines, with their numerous belts, pulleys and shafting, shown in diagrams 1 and 2, representing the apparatus on the ground and first flats. The D. C. power generators and engines are located in a separate building.

The upright engine, known as No. 1, shown next to Queen street in diagram 1, was connected by two 30" belts to a line shaft from which were operated four 75 k. w. and two 150 k. w. alternators and 2 exciters. Operated from the line shafting connected to No. 2 engine were three 75 k. w. alternators and an exciter.

No. 3 engine, located on the ground flat was belted by a 50" belt to a line shaft on the first flat, shown in diagram 2. To this line shafting were connected seven 75 k. w. alternators, two exciters, one 45 k. w., D. C. generators, five 40 light and one 35 light arc machines. These latter were used only as spare capacity for the series arc system located in the east end station, and the 45 k. w. generator as spare capacity for the D. C. power system. The total capacity of the machines connected to this line shafting was much more than the capacity of the engine, consequently only part of the machines connected to No. 3 line shafting could be fully loaded at any one time. With that part of the shafting thrown out of service by the clutch shown at "A"

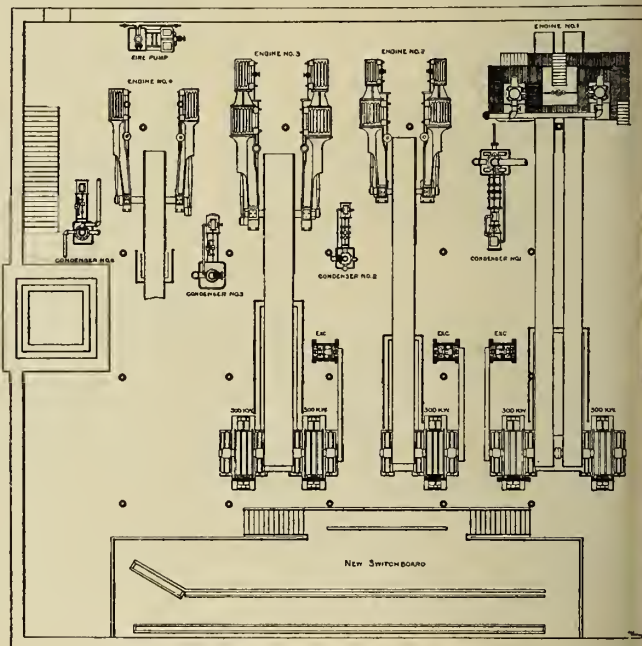


DIAGRAM NO. 3.

diagram 2, there yet remained connected to the shafting in service three 40 light arc machines, which had to be up to speed whether they were required or not. To No. 4 engine were connected by line shafting two 75 k. w. alternators and three 50 light arc machines.

It will be unnecessary to give in detail the heavy line shafting losses, the dangers and disadvantages of such an arrangement of machines as shown in diagrams 1 and 2, as they will be apparent at first sight.

There was another danger which menaced the safety of the entire system—a wooden switchboard, the capacity and arrangement of which was entirely inadequate for the service required of it.

The alternators connected to the same engine were run in parallel, six operating in parallel from No. 1 engine, three from No. 2, seven from No. 3 and two from No. 4 engine. The ordinary advantages to be gained from operating in parallel were to a great extent offset by the fact of there being no clutches on individual machines. This also introduced irregularities and interruption to the service from armature burn-outs. In running so many comparatively small units in parallel it was difficult to overcome the "idle" currents in the alternators, and the numerous belts and pulleys required a nicety of adjustment which was hard to maintain after synchronism had once been established.

The foregoing statements setting forth past conditions have been made to illustrate the results of a gradual growth. It is needless to state that had the present demands for light and power been foreseen, and the efficient apparatus of to-day been available, the station equipment, in all probability, would have been far different from that which necessitated its entire reconstruction. The first step of this reconstruction was the rearrangement of the overhead lines. These had been divided into three routes, each taking approximately one third of the station output. The relative positions of the wires on the poles forming these routes were such as to cause serious fluctuations in the lights, due to mutual induction. This became so objectionable that it was necessary to operate all the circuits forming one pole line from one set of alternators running in parallel to get comparatively steady service. When the total load was too heavy to be run from one set of alternators, this condition of the pole lines neces-

represents the generating plant as it at present exists, occupying one instead of two flats—eighteen old generators being replaced by five 300 k. w. generators of the S. K. C. inductor type, the latter being belted directly to the engines. Also, in diagram 3 is shown the outline of the new switchboard, located overlooking the generator and engine room.

The five 300 k. w. S. K. C. 2 phase generators were built in the manufacturing department of the Royal Electric Company. To utilize the engines in their existing condition it was necessary to have the shafts of the two alternators for No. 1 engine rigidly connected, also the shafts of the alternators for No. 3 engine rigidly connected. The machines on No. 1 engine are run in parallel, also the two in No. 3 engine are run in parallel. This arrangement practically makes 600 k. w. units on both of these engines, at the same time having the many advantages of being able to subdivide these units and have four independent alternators.



MAIN DISTRIBUTING SWITCH-BOARD, ROYAL ELECTRIC COMPANY'S ALTERNATING CURRENT LIGHTING STATION, MONTREAL.

sitated the running of two or three engines underloaded, introducing a serious loss in coal consumption. The relative positions of the wires on the poles were changed to overcome this mutual induction and most satisfactory results were obtained, as after this change it was possible to operate any circuit from any engine without the slightest fluctuation resulting.

The transformer system was next rearranged, the old transformers being replaced by ones of close regulation and small core losses and secondary systems established wherever economical. The extent to which the latter was carried may be judged from the fact that 1161 old transformers were replaced by 628 "Stanley" transformers, with a consequent reduction in leakage load of 245 amperes, representing a tremendous saving in coal.

After getting the lines in shape attention was next directed to constructing a new switchboard and installing new alternators.

Diagrams 1 and 2 show the generating plant prior to its reconstruction, occupying two flats. Diagram 3

Due to the crowded condition of the station prior to reconstruction, the installing of the new machines and construction of the new switchboard, at the same time maintaining continuous service, introduced many conditions and difficulties not encountered in the erection of a new station. All of the available space being occupied by old equipment it was not possible to first install new apparatus to replace that which was to be removed. It was therefore necessary before beginning the station reconstruction to await such time as the capacity of one of the engines could be dispensed with, with the least danger of running short of capacity in case of accident to one of the other engines.

To have at all times sufficient capacity to meet the requirements and at the same time to have spare capacity for emergencies was of course the difficult part of the reconstruction.

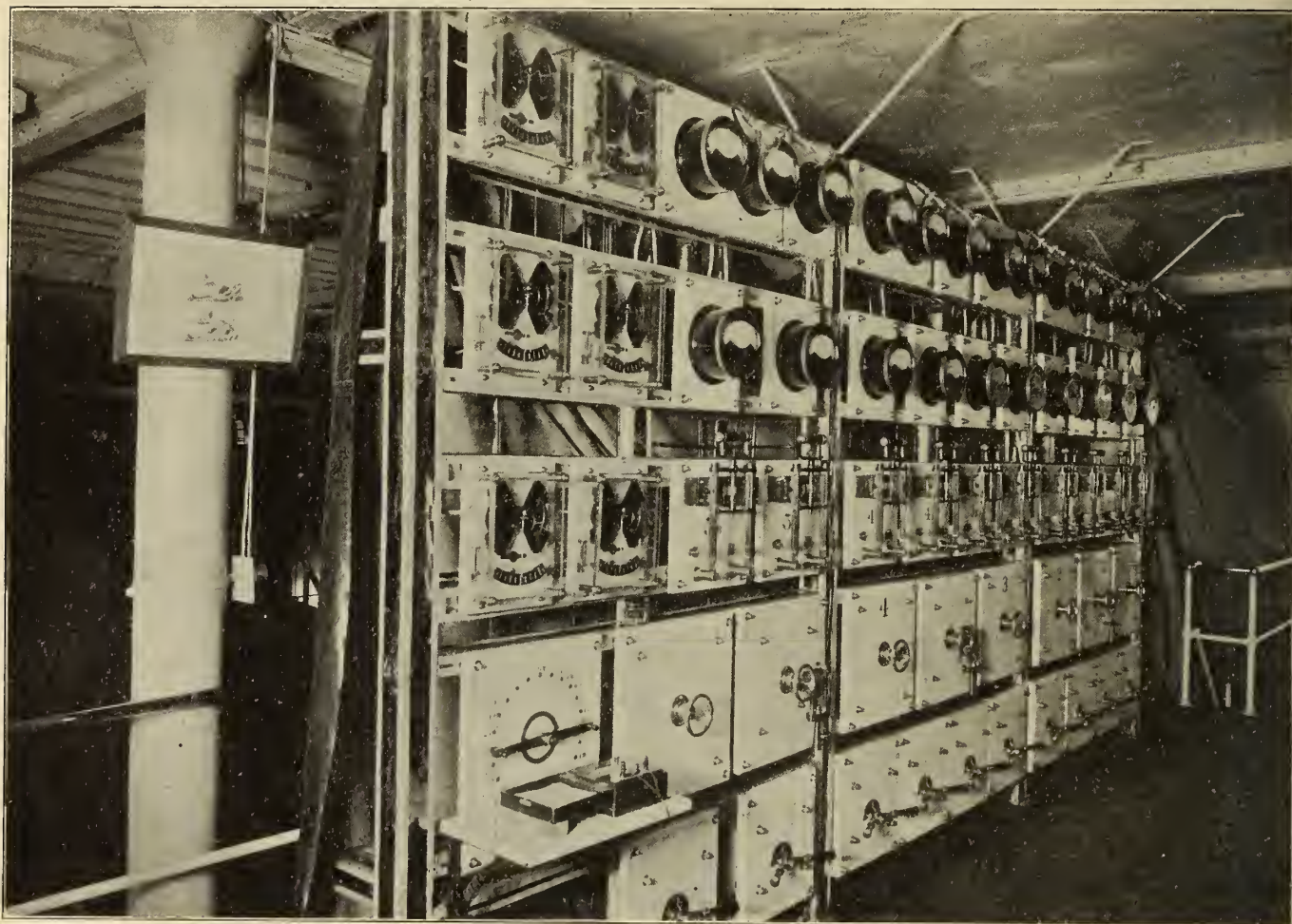
Work was commenced in the station by the removal of the old equipment connected to No. 2 engine and replacing it by one 300 k. w. S. K. C. generator. The apparatus connected to No. 3 engine was next replaced

by two 300 k. w. S. K. C. generators. No. 4 engine was then reconnected to part of the line shafting on the upper flat which had previously been run by No. 3 engine. By this time the fall load was near at hand with the new machines yet to be installed on No. 1 engine. This was an unpleasant fact confronting us at this time, and it was a great temptation to allow the old equipment to remain on No. 1 engine until spring, but the saving sure to follow the installation of new generators on this engine made it advisable to complete the reconstruction. The load had increased to such an extent that it was not safe to be without at least, part of the capacity of No. 1 engine at all times. To provide for this there was installed, to be run temporarily from No. 1 engine, one 300 k. w. generator, and later, owing to a heavy increase in load, one 180 k. w. generator, both belted directly to the engine and running with very short centres to allow of the new generators intended to be run regularly from this same engine be-

larly difficult operation with the service "dead", the transferring without any interruption to the service was a rather ticklish undertaking. It was made in the day time, within a period of ten hours, without any interruption to the service or inconvenience to the customers, in fact, they were not aware at any time of the changes taking place in the station.

Cut 2 represents the generator board and cut 3 represents the circuit board and the terminal board of the new switchboard. The board has been designed on the "universal combination" plan, by means of which there is a universal interchangeability of circuits, dynamo and exciter connections, enabling any circuit to be operated from any generator, and any generator to be excited from any exciter.

Diagram 4 shows the arrangement of switches, rheostats and instruments on the generator board. The instruments on the top row, excepting the three mounted on single bases, are voltmeters, there being



GENERATOR SWITCH-BOARD, ROYAL ELECTRIC COMPANY'S ALTERNATING CURRENT LIGHTING STATION, MONTREAL.

ing placed in their proper positions, in line with the generators connected to No. 2 and No. 3 engines.

During the time of installing the new generators there was also being constructed the new switchboard. From the diagrams it will be seen that the location of the new board brought it directly over several of the old generators, and the close quarters in which the work was done in the station will be appreciated from the statement that the iron framework supporting the floor of the board cleared the eye bolts on top of these old machines, still operating, by only six inches.

The installation of the five 300 k. w. generators was completed by the middle of October just at the beginning of the heavy winter load, and the new 2 phase board was completed about the same time.

The transferring of the service from the old to the new switchboard transformed the entire alternating system from a single to a two-phase system. The operation of transferring the circuits from the old to the new board was, of course, made with all circuits alive, and while this transfer would not have been a particu-

larly difficult operation with the service "dead", the transferring without any interruption to the service was a rather ticklish undertaking. It was made in the day time, within a period of ten hours, without any interruption to the service or inconvenience to the customers, in fact, they were not aware at any time of the changes taking place in the station.

The circuit board consists of two rows of 4-pole switches, two switches being required for each circuit. These switches are so connected that by a single throw of one switch a circuit can be connected to any generator. Above the rows of switches are mounted ammeters, one ammeter for each phase of each circuit, and above the ammeters are fuse blocks.

In the rear of the circuit board is the terminal board, on which are mounted a single row of 4-pole switches, one switch for each circuit, and an auxiliary set of buss bars, and below these a row of recording meters. By means of these auxiliary switches and buss bars any circuit panel or panels on the main circuit board can be cut "dead" and the circuit or circuits transferred to the terminal board. As the buss bars on the latter can be connected to any alternator, the terminal board dupli-

cates to a great extent the circuit board and generator board. During the day the entire output can be handled from the terminal board.

Diagram 5 gives a floor plan of the switchboard and detail of iron framework supporting the slate floor. The location of the switchboard, shown in diagram 3,

over this two layers of mica, the edges of this framework being protected for mechanical purposes with fibre angles. This character of framework for switchboards was first used in the construction of the switchboard of the United Electric Light and Power Company, New York City, and after that company had made extensive

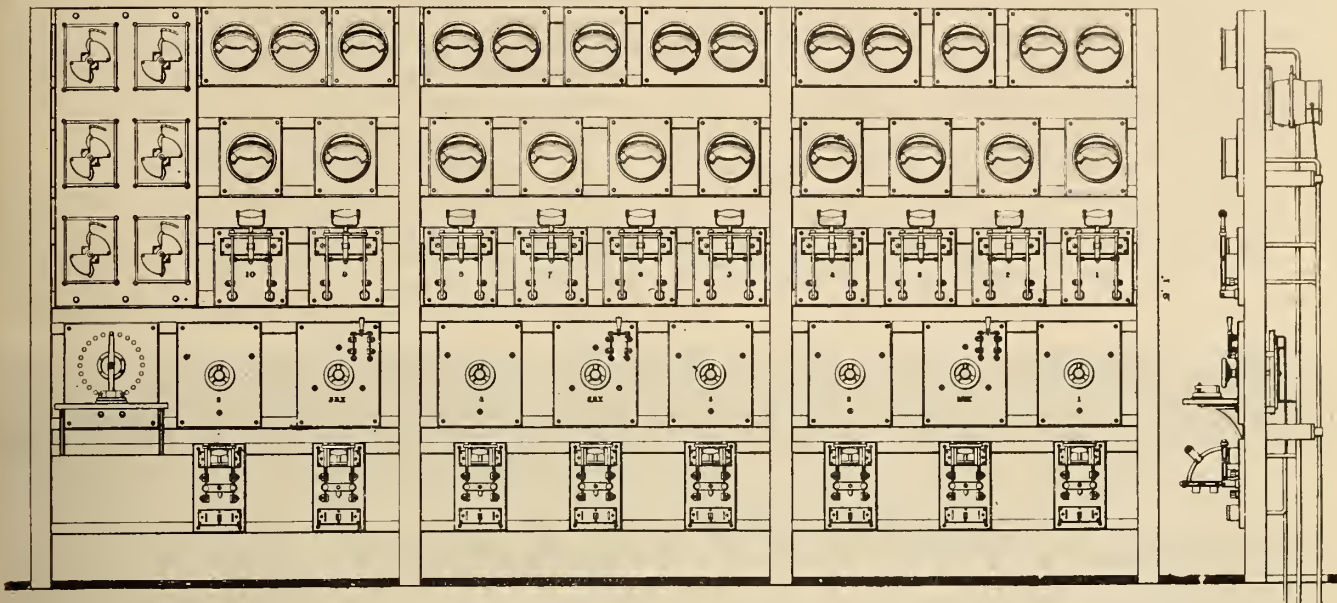


DIAGRAM NO. 4.

General Plan of Frame with plate covering removed

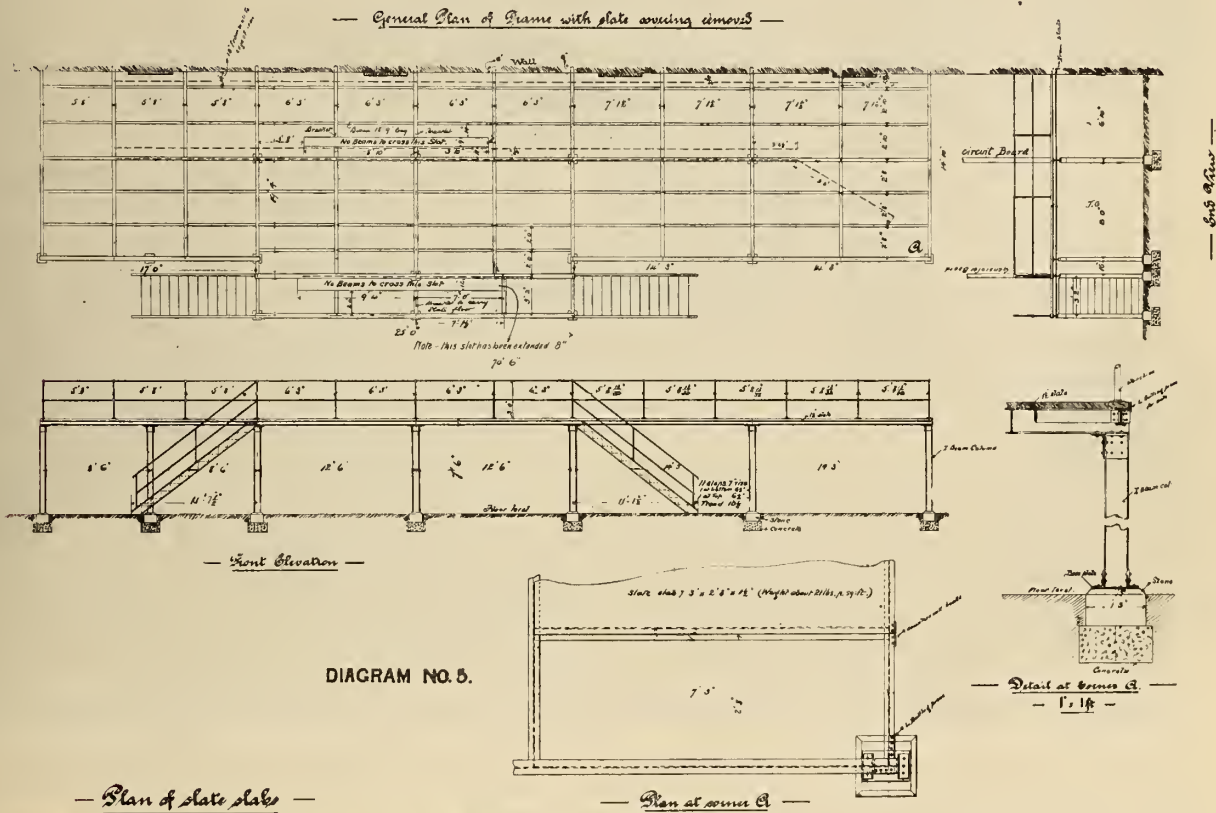
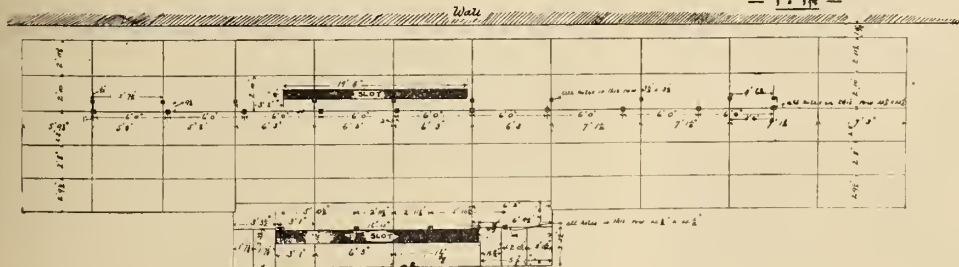


DIAGRAM NO. 5.

Plan of slate slab

Plan at corner C



PLANS AND DIAGRAMS OF NEW SWITCHBOARD IN ROYAL ELECTRIC COMPANY'S ALTERNATING CURRENT LIGHTING STATION, MONTREAL.

directly in front of the driving belts of the engines, is of course not desirable, but it was the only available space. There have been erected heavy wrought iron bars immediately in front of the belts for protecting the board in the event of a driving belt breaking.

The framework of the switchboard consists of seasoned white oak, over which is a layer of asbestos, and

experiments with iron and frame switchboard construction. It is practically fireproof as well as being a good insulator, and from the severe tests during the past four years which it has withstood, there are reasons to believe that it is a very superior and satisfactory framework for switchboards.

The switches, fuse blocks, etc., are of the standard

S.K.C. type. They are independently mounted on the switchboard, which permits of great interchangeability of all parts of the board.

From the preceding account it will be noted that every part of the alternating system of the Royal Electric Company was rearranged and redesigned. The lines and circuits were rearranged to overcome objectionable inductive effects and to transform them from single to double phase circuits. 1,161 old transformers were replaced by 628 new transformers with a reduction in leakage load of 245 amperes. Eighteen old style single phase generators, with their revolving wire on the armatures, collector brushes and rings, their numerous belts, pulleys and line shaftings, were replaced by five S.K.C. generators of the inductor two phase type, the latter being belted directly to the engines. The old wooden single phase board was replaced by a new fire-proof two phase board designed to distribute current for light and power from the same circuit.

QUESTIONS AND ANSWERS.

H. K., Walkerville, Ont., writes: "What kind of safety valve would you recommend for a stationary boiler—a lever valve or a spring or pop valve?"

ANSWER.—A lever valve is recommended for simplicity, and also for efficiency. It should be carefully set, and the weight absolutely fixed in position so it cannot move. The valve should also be operated now and again, both by raising steam to blowing point, and also by hand at lower pressures, in order to ensure its not sticking to the seat.

POINTS ON SHAFTING.

THE author of a paper on "Shafting in Factories," presented before the American Society of Mechanical Engineers, summarizes his conclusions on the subject as follows:

It seems to the writer that in ordinary machinery es-



SPACE UNDERNEATH SWITCH-BOARD, SHOWING WIRES FROM GENERATORS, ROYAL ELECTRIC COMPANY'S ALTERNATING LIGHTING STATION, MONTREAL.

All of this reconstruction has been designed and carried out on plans which adapt the system to be served either from its existing steam plant or from the Chambly water power plant. Upon the delivery of power from Chambly, the five 300 k.w. generators recently installed will be used as synchronous motors, from which will be operated the D.C. arc machines.

The system affected by the above-described changes, operating for five months under the old conditions, from Oct. 1, '94, to March 1, '95, consumed 2,931 tons of coal more than was consumed in the five months from Oct. 1, '96, to March 1, '97, the number of incandescent lights being 10,200 more during the latter than during the former period.

ALL RIGHT.

MR. S. H. Reesor, proprietor of the St. Mary's Electric Light Co., writes: "Enclosed please find \$1.00, subscription to the ELECTRICAL NEWS. Your paper is all right."

establishments an observance of the following rules might effect a saving that would be noticeable in the annual balance.

1. Use pulleys of large diameter on counters and narrow fast-running belts.
2. Use nothing but the best oil and plenty of it, catching all drip, and either purifying it or using it for some other purpose.
3. Have all the shafting and counters oiled regularly and do not depend too much on automatic oiling.
4. Inspect line shafts from time to time, and see that they are in line and can be turned easily.

Many line shaft boxes bind at the sides when screwed down, sometimes increasing the turning moment 100 per cent.

The town of Fort William, Ont., is obtaining estimates for an electric light plant.

The Bushnell Oil Company has purchased the Alpha Refining Works at Sarnia, Ont., and will reconstruct and modernize the plant.

CANADIAN ELECTRICAL ASSOCIATION.

SOME PARTICULARS OF THE APPROACHING ANNUAL CONVENTION.

SINCE the announcement in our last issue of the dates selected for the convention of the Canadian Electrical Association at Niagara Falls—viz., the 2nd, 3rd and 4th of June—very satisfactory progress has been made with the arrangements. A meeting of the Committee on Arrangements was held at Niagara on March 27th, at which there was a full attendance. A very satisfactory programme was drafted, and sub-committees appointed to perfect details and complete necessary arrangements.

Pending the completion of arrangements, it is not possible in this number to give the programme in detail. This much may be said, however, that satisfactory

interest and value in those which shall be presented. Several of the papers which have been arranged for and are in course of preparation are in hands which leave no room to doubt that this aim will be reached. The subjects of these papers have been chosen with a view to interest and instruct persons connected with every branch of electrical work. It should be borne in mind, however, that the most instructive part of the proceedings of a convention of this kind should be the discussions upon the papers. There was a marked improvement in this particular noticeable at the last convention, and it is greatly to be desired that members will go to the coming convention prepared to enter actively into the discussion of the points brought out by the authors of the various papers. A comparison of notes and experiences at gatherings of this sort is most helpful.



NIAGARA FALLS—SCENE OF THE CONVENTION OF THE CANADIAN ELECTRICAL ASSOCIATION ON JUNE 2, 3 AND 4, 1897.

terms have been made with the proprietors of the new Hotel Lafayette for the accommodation of members and friends of the Association while in attendance on the convention. This hotel has been recently erected, is most comfortably fitted up with all modern appointments, and is situated directly opposite the Suspension Bridge, presenting an excellent view of the great cataract.

The sessions of the convention will be held in the Assembly Hall of the Dufferin Cafe' in Queen Victoria Park, where the annual Association Banquet will also take place on the evening of the second day.

It is the purpose to compress the business of the convention into the first two days, leaving the third day entirely free for sight-seeing. With this object in view the number of papers will be somewhat reduced, and an effort made to secure the highest possible standard of

It is understood to be the intention to introduce a new feature at the coming convention, in the shape of a "Question Box." Members are invited to forward to the Secretary at any time prior to the date of the convention, but preferably as soon as possible, questions on any electrical subject on which they may desire information, and answers will, if possible, be given at the convention.

Mention is made elsewhere of matters which at present should have a vital interest for the owners of central stations, and upon which we hope to see action taken at this convention. The time has arrived when central station owners in Canada should get together and give united consideration to legislation and other matters affecting their interests. In the Canadian Electrical Association they have an organization able and willing to be of service in this direction. It only remains for

those who should be most interested to connect themselves with the organization, and strengthen its hands for this particular work.

So much for the practical business aspect of the convention. From the standpoint of interesting sight-seeing and pleasure, there is assurance that this convention will be a most attractive one. The natural beauties of Niagara—electric railways on either side of the Niagara gorge—one skirting the river bank, the other far down the side of the precipice near to the boiling current; the wonderful generating plant of the Cataract Construction Co.; the acetylene gas and electro-chemical works; the system in use for the transmission of power to Buffalo; the electric railway connecting the Falls with Buffalo—all these and more will be open for the inspection of the visitors—forming a combination of interesting sights such as cannot be witnessed elsewhere in the world.

A special committee has been appointed to provide for the annual banquet to members and invited guests on the evening of June 3rd, and it can confidently be promised that the affair will be thoroughly first-class and enjoyable. The catering will be in the hands of Mr. Barnett, proprietor of the Dufferin Cafe', and late of the House of Commons restaurant at Ottawa, of whose ability there can be no question.

Persons connected with the electrical interests who have not yet connected themselves with the Canadian Electrical Association should lose no time in doing so. There should be a large turn-out of such persons, as well as of present members, at Niagara on June 2nd, 3rd and 4th.

PERSONAL.

Mr. James Yuill, formerly city electrician of Winnipeg, died in that city last month. He was at one time a resident of Montreal.

Mr. J. W. Moyes, manager of the Metropolitan street railway, lately returned from the United States, where he arranged for the new rolling stock required by the company.

Mr. Thomas W. Lester, ex-president of the Hamilton, Grimsby and Beamsville Electric Railway, was recently married to Miss Emma Springer, daughter of the late Dr. Springer.

Mr. W. G. Blackgrove, who for many years had charge of the steam plant at the James Morrison Brass Co.'s works, has accepted a position as traveller for Wm. C. Wilson & Co., steamboat, railroad and mill supplies, Toronto.

Mr. J. A. Rutherford, a native of Hamilton, Ont., and formerly with the Edison Co. in that city, after having been connected for a number of years with the Westinghouse Co. at Pittsburgh, has recently taken a position as salesman in the street railway department of the Johnston Company, at Johnstown, Pa.

Mr. D. C. Dewar, local manager of the Bell Telephone Company at Ottawa, has received promotion to the management of the Montreal office, and is succeeded by Mr. J. E. Macpherson, who has been travelling auditor of the company for eastern Ontario and Quebec. Mr. Dewar is well qualified to fill the responsible position to which he has been appointed.

Mr. J. J. Franklin, of Toronto, has been appointed secretary of the Rossland Board of Trade, and will shortly leave for that city. Mr. Franklin was for ten years superintendent of the Toronto Street Railway, and during his management the road was converted into an electric system. After leaving Toronto he went to Paris, where he organized a tramway service for an English syndicate. Lately his attention has been devoted to securing a franchise for the Chatham City and Suburban Electric Railway Company.

The Electric Power Company, of Fraserville, Que., proposes to extend its telephone lines as far as Quebec.

The City Council of Waterloo have reached an agreement with the Waterloo Electric Light Company for lighting the town by electricity.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

NOTE.—Secretaries of Associations are requested to forward matter for publication in this Department not later than the 25th of each month.

MEETING TO DISCUSS LEGISLATION.

The stationary engineers have taken action in the direction of obtaining legislation from the Dominion government. On the 17th of March a committee of the Ontario Association conferred with a committee of Toronto No. 1, C. A. S. E., at Toronto, when it was resolved to ask for an inspection and license law. A sub-committee, consisting of Messrs. A. M. Wickens, of Toronto, A. E. Ames, of Brantford, and James Devlin, of Kingston, was appointed to proceed to Ottawa to explain the objects of the bill to Parliament, and to endeavor to secure its adoption. The draft bill to be presented will contain several important changes from that placed before the Ontario House recently. It is intended to exempt from the working of the law small steam plants, perhaps up to 15 h. p., to grant a permit to the older engineers to retain the positions held at the time the act becomes law, or to operate a similar plant, and to make such provision as will remove the opposition which has in the past been met with from saw mill owners, by allowing them a specified time in which to obtain the services of a licensed engineer. With these points overcome, it is hoped to obtain such a law as will elevate the standard of steam engineering and lessen the number of disastrous explosions which occur each year.

HAMILTON NO. 2.

An open meeting of the above association was held on the 19th of March. Mr. Ballard, Inspector of Public Schools, gave an interesting lecture on decimals and fractions. Mr. Edwards, architect, made a few remarks, and past-president W. G. Blackgrove, of the Executive Council, gave a short address. The certificates of membership were handed to the members by the president. Our annual dinner will take place on April 15th.

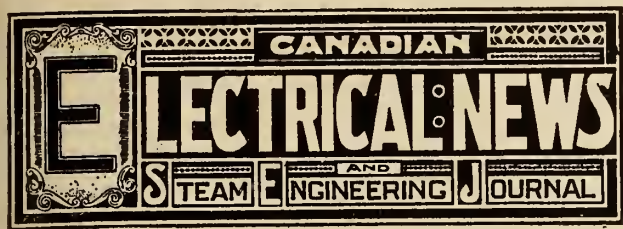
JOHN IRONSIDE, Rec.-Secretary.

LONDON NO. 5.

At the regular meeting of London No. 5, held on March 4th, a lively debate took place on "Strength of Steam Boilers," and some very interesting illustrations and calculations were made. The members were presented with certificates of membership.

An interesting feature of the meeting held on the 18th ultimo was a lecture by Mr. H. W. Page, of St. Mary's, on the regulator and the atmospheric governor. Mr. Page, who is a former Londoner, is the inventor of several engineering appliances, and his address was much appreciated. He congratulated the engineers upon the advancement made in late years in engineering science.

"Electric Transmission by Power," by Dr. Louis C. Bell, is a book containing upwards of 500 pages, with 230 illustrations. It describes in a very simple manner the fundamental facts concerning present practice in electrical power transmission, and shows by what processes the work is planned and carried out. The work is divided into thirteen chapters, in which is described and illustrated such apparatus as are typical of the methods used, rather than representative of any particular scheme of manufacture or fashion in design, making it especially valuable to students who desire to obtain knowledge regarding the principles of electrical construction. Price \$2.50. The W. J. Johnston Company, New York.



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SUBSCRIPTIONS.

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EDITOR'S ANNOUNCEMENTS.

Correspondence is invited upon all topics legitimately coming within the scope of this journal.

The "**Canadian Electrical News**" has been appointed the official paper of the Canadian Electrical Association.

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The Study of Electricity.

It may serve a useful purpose to point out to intending students of electricity that a good knowledge of mathematics is a most essential requirement. The student who is not well grounded in mathematics would do well to properly equip himself in this direction before entering on an electrical course. Of the students who take this course in our scientific schools, at least thirty per cent. fail in their examinations through lack of the requisite knowledge of mathematics. It is safe to say that no young man who has not successfully mastered the mathematical problems presented to graduating students of the high schools can hope to succeed in an electrical course.

Enforced Cleanliness in Cars.

THE cars of the Toronto Railway Company have for some time past carried placards requesting passengers to refrain from spitting on the floors. No doubt the principal object of the company in seeking to put a stop to this practice was to remove a cause of offense to the sensibilities and injury to the clothing of well-mannered passengers. There is, however, a more important phase of the subject, viz., the danger to health from exhalation of consumptive germs. Realizing the necessity of protecting the public from this danger, the Board of Health of New York have placed placards in the street and elevated cars of that city forbidding spitting on the floor. The Board of Health of Los Angeles, California, two years ago passed an ordinance against expectorating on the streets and in public places, but it is said that the measure has not been enforced. The danger from contact with consumptives is illustrated by the fact that in Southern California, which has been the resort of large numbers of persons afflicted with this

disease, the native population has become seriously affected. It is to be hoped that our Canadian railway companies and boards of Health will give the attention to this matter which its importance requires.

Methods of Interior Distribution.

AN increasing number of large buildings are being equipped electrically, provision being made for the easy running of the distribution system by the installation of interior conduits during the progress of construction of the building. As a result several different forms of conduit are being placed on the market, presenting many different features. There is plain gas piping with rounded elbows, insulating piping, iron pipe with an insulating lining. But a great number of prominent electrical engineers have agreed that for all purposes the ordinary iron pipe is as good as can be used, the wire to be drawn into it being heavily insulated. It is interesting also to observe that alternating current wires are both drawn into the same tube, it having been found that the counter E.M.F. of induction (in the iron pipe) set up by using only one wire in the tube was very noticeable.

The Power of Electric Waves.

MR. W. H. Preece, chief of the electrical department of the British postal system, is said to have induced the British Government to undertake a test of the possibilities of a method of telegraphing without wires, invented by a young Italian named Guglielmo Marconi. By means of his apparatus, consisting of a transmitter and receiver, each about 15 in. x 10 in. x 8 in. in size, Marconi claims to have sent and received waves over or through a hill three-quarters of a mile in thickness, and over a distance of 100 yards through seven or eight thick walls of the general post office building in London. His belief is that by the method he is using electric waves can be transmitted through the air over a distance of at least 20 miles, and made to pass through all kinds of metals and solid substances. This discovery following close upon that of the Roentgen rays, opens to our view wondrous possibilities, and shows that in some respects electricity is indeed yet in its infancy.

Acetylene Gas.

NOTWITHSTANDING all unfavorable criticisms, which in great measure are founded on commercial rather than on scientific considerations, the manufacture of acetylene still continues, and it is only reasonable to admit that it has its field as an illuminant, and that in certain conditions it may compete favorably with electricity. At the same time it is doubtful whether, in the present state of its manufacture or use it can be said to be fully understood, its effects on the conduit for distributing it having yet to bear the test of time; and its physiological effects being rather startling in some cases. Professor Mosso, of Italy, has been recently conducting some researches into the action of the gas when leaking into the atmosphere, and found it strongly poisonous. Experimenting on animals—dogs, cats, birds, etc.—he found that a small quantity in the air or inoculated in the blood is followed by death, directly attributable to it; a mixture of 20 per cent. acetylene (which is, of course, larger than would ever probably be an actual case) in the air was followed by death in one hour. The effects of a small leak, while not probably

being necessarily fatal, might, at least, be the permanent injury of some of the respiratory organs.

Transformers.

THERE can be no question of greater importance to a central station than the class of transformers used and their distribution. Their selection on the basis of price only is a mistake that is of too frequent occurrence, and that results in loss direct and indirect. Their regulation is a matter that is of importance directly to the consumer, and indirectly to the central station, as anything unsatisfactory in the service naturally reacts at once on receipts. The magnetizing currents and core losses are felt directly by the coal pile, and in very appreciable amounts. A very prominently known transformer of 6,000 watt capacity, has a magnetizing current of .06 amp. on a 2,000 volt circuit; anyone can figure for himself what this means in point of coal consumption during a year, and multiplied by the number of transformers gives the total consumption owing solely to this cause. It is also easy to calculate how much more coal would be consumed by a transformer of same capacity having a magnetizing current of .1 amp. or .04 amp. greater than in the above case. A few such calculations will go very far towards proving in a plain arithmetical manner how very extravagant a cheap transformer can be, and per contra that a good one is worth money.

Municipal Lighting.

A BILL now before the Ontario Legislature gives municipalities of less than 5,000 inhabitants the power to issue 30 year debentures for the purchase of electric lighting apparatus. The bill received considerable opposition in committee on the ground that the life of an electric plant is at longest twenty years, and that the time at which the debentures should mature should correspond to that at which the investment representing the proceeds of such debentures would be wiped out. The advocates of the measure urged 30 years on the ground that this would correspond with the period allowed for water works debentures, and would enable small municipalities which could not afford to construct and operate water works alone, to reduce the operating cost by combining with the water works electric lighting. The mayors of several interested municipalities appeared before the committee to urge the passing of the measure. The owners and managers of electric lighting companies should be able to see in this legislation the trend of events, the manner in which their interests are likely to be affected, and the necessity for greater watchfulness and united effort in the direction of self protection. The Canadian Electrical Association has done, and is doing, what it can to guard the interests of the electrical companies against hostile legislation. If the electrical companies whose interests it is looking after will give the Association their united and hearty support, a great deal may be done to protect the investments of those engaged in the electrical business. One thing to our mind appears clear, viz., that legislation should at once be enacted compelling municipalities who may desire to do their own lighting to purchase by arbitration the plant of the existing private company. If this is not done, hundreds of thousands of dollars of private capital invested in electrical machinery will be wiped out of existence. An electric lighting company differs from other manufacturing companies in this, that it

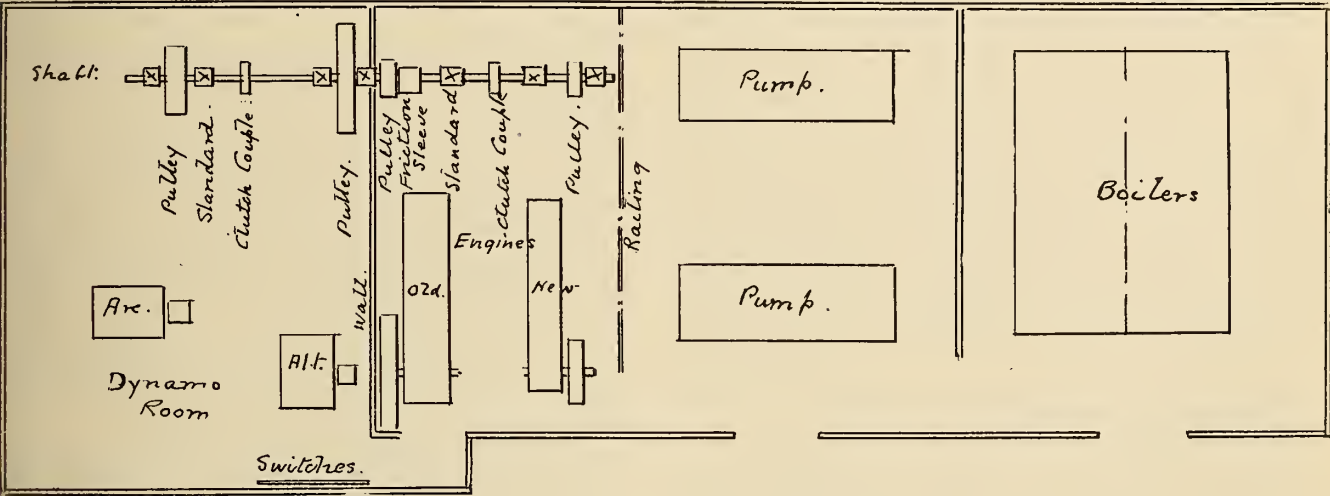
cannot easily change its location. Each town has its own lighting company, whose plant has been purchased with a view to the special requirements of a particular locality there would be difficulty in finding another opening were the company forced to change their location, and if an opening were found, much of the apparatus would become valueless, in as much as it could not be adapted to the new conditions, and a large amount of new material would have to be purchased. For this difficulty of making a change of location is due the fact that prices for electric lighting have been forced down far below a fair basis. The municipalities have known the disadvantage at which they held the companies, and have not been slow to take advantage of it. It is time, as already stated, that those who have invested their means in the electrical business should awake to united effort for their self's protection.

THE MUNICIPAL ELECTRIC LIGHTING PLANT AT GODERICH, ONT.

(CONTRIBUTED.)

NOTWITHSTANDING the many strong arguments urged by political economists against the morality and advisability of municipal control of electric lighting and waterworks services, the great public, who is the final court of appeal in such matters, has

for the purchase of the necessary machines. The corporation engaged the services of Mr. G. White-Fraser, consulting electrical engineer, Toronto, to take entire charge of the work, and all plans, specifications, etc., for steam and electrical apparatus were drawn by him, and the work done under his personal supervision. They took the very sensible view that if they engaged an engineer at all they had better take his advice and be guided by him in technical matters, and the result is that every day proves the wisdom of such a course. The waterworks building is on the lake side, the town itself being on the high level of the surrounding country about 250 to 300 feet above this, the power house about 3,000 feet from the Square, and the town spreading out half to three-quarters of a mile on every side. An engine of nominal 60 h.p. used to run the two arc machines, being belted to a light shafting placed on brackets near the ceiling of the pump room, which in its turn was belted to the arcs. It was decided to purchase a 30 ampere, 2,000 volt (nominal 1,000 light) alternator, and to replace the commercial arcs by incandescent; thus the steam power required must be enough to run the alternator and the 35-light 2,000 c.p. arc together. An offer was received from the engine builders to take out the old engine and to put back on the same foundation one new one powerful enough to do the combined service, but it was decided that to do so would result in great inefficiency in operating, as there would be times when the arcs were not in and when the alternator had only about a quarter load, and then the 150 h.p. engine would be running only 25 h.p., or 17% load. Therefore the old engine, which required only some slight repairs to put it in excellent condition, was speeded up to about 1100 r.p.m., which brought up its capacity to about 85 h.p.



MUNICIPAL ELECTRIC LIGHTING PLANT AT GODERICH, ONT.

decided in its favor in several instances recently; and so far the results seem to have justified the decision. The town of Goderich in western Ontario is perhaps the most prominent example, for the reason that it possesses a population of nearly 5,000, is a county town, a railway terminus, and is growing rapidly in importance as a manufacturing center. Goderich was one of the earliest towns established by the Canada Company, and is most attractively laid out, the streets radiating from a central space, the center of which is occupied by the County Buildings, and being broad and level. A number of the old well-known Ontario families originated here, their residences being built solidly in the "Colonial" style, and standing in beautiful grounds laid out in parterres and orchards. The business part of the town is mostly around the central space or "Square," as also are the large hotels, the opera house, two banks, and various offices, lodge rooms, etc. There are numerous large and handsome churches; the Roman Catholic and English churches, both beautifully lighted, and others to follow. The private residences, as might be expected in a town of such importance, are of a most superior character, and as the corporation has exercised the most careful and minute supervision over every detail of installation, inspecting wiring work, equalizing pressures and watching the interests of its customers, the light is every day growing in popularity and the business greatly increasing. A waterworks system was put in some years ago, to which was shortly added a street and commercial arc system, the former of 2,000 and the latter of 1,200 candle power arcs. Within the last four years numerous applications were made to the Council for franchises for the incandescent lighting of the town, but it was eventually decided to take a vote on the subject, and the ratepayers in August last year authorized the expenditure of \$6,500

at quarter cut-off 80 lb. steam. A smaller engine of 35 rated h.p. at quarter cut-off 80 lb. was purchased and placed in the position indicated in the diagram, which had previously been occupied by the two arc machines. The foundations for the new engine and new shafting were excavated and built without interfering with the regular arc service, as the machines were lifted off the floor on beams, and so operated off the old shafting until the building extension and the new shafting had been completed, when they were moved out to allow of the new engine being placed. Ultimately, the whole arrangement was as shown in diagram, room being left for the addition of more steam and electric machinery when conditions required it. The shafting is of peculiar interest, as the arrangement of clutches permits the throwing in or out of either engine or dynamo, so that no more engine capacity is running at any time than the actual load requires. Finally, the two engines were so piped that they can either exhaust free or be run condensing with the pump's condenser. (Diagram 1.)

The entire wiring system has been so designed as to secure three very important advantages: Very low drop; perfect equality of pressure everywhere; and extreme simplicity. The total drop allowed between generator and lamps is less than 5%, a considerable proportion of this being on the feeders between generator and main distributing center on the Square. The primary system is two-wire, a single-phase alternator having been installed; while the entire secondary system is 3-wire with banked transformers, wires being interconnected at corners so as to form a network. An interesting feature is that the connections are made at the back of the houses on the Square, the poles being placed in back-yards, and the wires, etc., not disfiguring the street. The wiring system was designed with a view to the ulti-

mate requirements of the town, and not merely to meet the present demand; hence there is a unity and coherence of plan not possible where small additions are made from time to time without reference to the whole. It was thought a more economical and efficient arrangement to spend money in copper and so greatly reduce the drop, than to save a little in wire and spend more in coal; therefore both primaries and secondaries are large in proportion to the distance and amperage. A feature of special importance to a power plant where fuel is expensive is the house-wiring and kind of lamp used, and this was wisely paid special attention to. A separate specification was drawn up by the engineer covering all installation details, such as class of material, maximum allowable drop between lamps; make, wattage and voltage of lamps, etc.; and separate tenders were called for on these specifications, the successful tenderer having to place a 5% cheque as guarantee, and being required to furnish a wiring plan of each installation for the approval of the engineer before being allowed to proceed. The public was then notified through the papers that no installation that had not been passed by the engineer would be accepted, nor current turned on. The result was that irresponsible wiring contractors were excluded; that all houses were wired on a coherent plan, and everything under the eye of the engineer—carrying out his general designs, the public also being protected against incompetent wiremen.

Many radical departures from hitherto accepted practice were made in the purchase of entire plant. In the first place, separate specifications were drawn up for (a) steam engine and shafting completely installed as per plans; (b) generator and instruments completely installed ready for test; and (d) house-wiring of not less than 500 lights, including lamps, sockets, labor, material, etc., at so much per light. The engine was specified as a certain h.p. at a given steam and a given cut-off, and a maximum speed regulation was laid down; it was also a condition that a test would be made of a certain duration, during which cards would be taken to prove h.p., regulation and valve adjustments, etc. The generator specification was perhaps that one which differed most from accepted practice, in that, without mentioning lamp capacity, it specified a certain amperage, certain voltage, certain voltage increase for full load, certain maximum allowable temperature, increase, etc., and it was specified that the test should consist of a run of 12 consecutive hours, during eight of which the amperes and volts must be so much, and during the other four they must be so much more, and in excess of the lamp requirements. The transformers were also specified in watts (not lamp capacity), and data was called for as to voltage drop, magnetizing currents, full, half and quarter-load efficiencies.

A considerable number of tenders were received, and as the conditions were the same for all—failure to meet guarantees entailing absolute rejection of plant and loss of deposit, etc.—it was felt that selection should be largely based on price. This was the principal basis of comparison, taking of course into careful consideration little differences of efficiencies, heating limits, etc., and assigning to them their money value. After reducing all to precisely the same basis of kilowattage, efficiency, heating, regulation, etc., taking also into account probable freedom from repairs, ease of effecting repairs, etc., the generator contract was awarded to the National Electric Co., of Eau-Claire, Wisconsin; the transformers to the Packard Electric Co., of St. Catharines; the wiring contract to the Rogers Electric Co., of London, and the engine and shafting to the Goldie & McCulloch Co., of Galt.

On October 21st and 22nd the entire plant was tested in accordance with the terms of the specifications. The engine was run for some time with and without load, and numerous cards taken; each friction or other clutch was examined and tested. As there were only some 200 lights wired up, not giving a full load for the machine, a water rheostat was constructed, and for 12 consecutive hours it was run on this load, temperature being previously taken. The test was conducted by Mr. Fraser, representatives of the National Electric Co. and of the Goldie & McCulloch Co. being present, and members of the waterworks and light committees. After shutting down, the temperature of armature, field coils and cores, commutator, etc., were taken, and the power dissipated through the water load checked against the temperature of feed water and the amount evaporated.

This is probably the first complete plant in Ontario that has been specified, purchased, installed and tested on the above system, and the results seem to justify it. The lights all over town are of equal brightness, drops being small and the transformer capacity greatly economized. Although the plant was started only in October, 1896, there are now 1,250 lamps wired

up, and orders coming in steadily. The rate schedule is of itself sufficiently interesting to mark out this plant as standing almost alone in cheapness. There are no meters as yet. The rates are as follows:—

For commercial lamps in stores.....	45 cents per month per lamp
For residences, up to 5 lamps.....	30 " " "
" " 6 and 7 lamps.....	29 " " "
" " 8 and 9 lamps.....	28 " " "
" " 10 and 11 lamps.....	27 " " "
" " 12, 13 and 14 lamps.....	26 " " "
" " 15 lamps.....	25 " " "

For over 15 lamps, 20 cents each, with a minimum of \$3.75 per month. Hotels—Bedrooms and dining room at residence rates; bar office, halls, etc., at commercial rates. Churches and halls—\$1.50 per lamp per year, with 10% discount for prompt payments. And these rates are expected to cover all expenses, including interest on debentures, sinking fund, depreciation, etc. The plant was installed during the mayoralty of Dr. Shannon, with Mr. P. Holt as chairman of the Waterworks and Light Committee, and Mr. W. H. Smith as engineer of the waterworks, who is responsible for operating and upkeep.

SPARKS.

The corporation of Liverpool, Eng., has purchased the assets of the United Tramways & Omnibus Co.

The town council of Port Hope, Ont., have invited tenders for lighting the streets by gas or electric light.

The St. Catharines Electric Light Co. will increase their capacity by installing an additional water wheel.

Messrs. Cooke & Son, of St. Catharines, will at once install an incandescent plant, and water wheels with which to operate the same.

The village council of Weston have extended the date for the completion of the Toronto and Suburban Street railway until the 30th of June.

Mayor Marks, of Port Arthur, Ont., has been granted permission by the Ontario government to purchase an electric light plant for lighting the streets of the town.

The Fort Erie Electric Railway Company have asked for and obtained permission from the Ontario legislature to run from Fort Erie to Chippawa, and from Crystal Beach to Ridgeway, and to operate their cars on Sunday.

Mr. C. R. Hosmer, manager of the C. P. R. telegraph systems, expresses his belief that the Pacific cable enterprise will be brought to a successful issue, and that if the cable is not laid from Vancouver it will be laid from some other point.

The Toronto Electric Light Company are rapidly extending their incandescent lighting business—a large demand coming from the principal hotels. The company are said to be at present installing incandescent lamps for new customers at the rate of 300 lamps per week.

At the convention of the National Electric Light Association of the United States which is to meet at Niagara Falls, N. Y., on the 8th of June, Prof. Carus Wilson, of the Electrical Department of McGill University, Montreal, will present a paper on "The Induction Factor, a New Basis of Dynamo Calculation and Classification."

The application of Edward Jemson and others to the Ontario Legislature for the right to develop the water power of the Kakabeka Falls, with the object of supplying electric light and power to Fort William and Port Arthur, is meeting with opposition from a Philadelphia company owning property on the river immediately below the falls.

A proposition has been made to generate power required for lighting the new municipal buildings in Toronto at the waterworks pumping station. The architect advised that an electric plant be erected at the buildings, but it is claimed that by putting in a large dynamo and utilizing the boiler power at the pumping station, a large saving to the city in operating expenses would be effected.

The Hull, St. Louis Dam and Victoria Springs Railway Company are seeking a broad gauge charter from the Ontario government. The promoters are Ottawa capitalists, who propose constructing an electric railway around the city. The first section will be built from Cumming's Bridge to the Victoria Springs, a distance of six miles. Following this there will be a belt line around the city to St. Louis Dam and other suburbs. The capital stock of the company is placed at \$1,000,000. T. G. Brigham is acting solicitor.

SPARKS.

The council of Richmond, Que., has asked tenders for electric street lighting.

The Roberval Electric Light Company has been organized at Roberval, Que.

The town of Huntsville, Ont., has taken over the electric light plant from W. S. Shaw.

The electric railway at Sherbrooke, Que., is expected to be in operation by August next.

The Ottawa Electric Railway Company intend erecting a pavilion at the west end park, to cost \$10,000.

The Windsor Electric Light and Power Company, of Windsor, N. S., will shortly erect a large brick chimney.

The Nova Scotia Telephone Company will replace the present line between Amherst and Truro with a metallic line.

The Royal Electric Co., of Montreal, have put a new switch-board in the electric light station at Sherbrooke, Que.

The Preston and Berlin Street Railway Company are asking for an extension of time for the commencement and completion of the road.

The electric light company at Barrie, Ont., have asked the town to purchase their plant at a valuation, or to give a ten years' franchise.

Mr. Ormond Higman, chief electrician of the Inland Revenue Department, Ottawa, recently gave an interesting exhibition of the Roentgen rays at Government House.

Edward Lachapelle has taken an action against the Ottawa Electric Co., claiming \$5,000 damages for injuries alleged to have been sustained by falling from an electric light pole.

Foss & Davis, proprietors of the Eastern Townships Electric and Machine Works, Sherbrooke, Que., have dissolved partnership. The business will be continued by Geo. F. Foss.

The Nanaimo-Alberni Railway Company, composed of Andrew Haslam, R. E. McKechnie, and others, of Nanaimo, propose to construct railways and operate telegraph and telephone lines.

W. H. Brandon and C. K. Hammond, of Brandon, B. C., and R. B. Kerr, of New Denver, are asking authority from the British Columbia government to supply electric light and power.

Recently some subscribers of the Bell Telephone Company at Brockville were connected with the Queen's Theatre, Montreal, and were treated to the performance over the long-distance wire.

The Cataract Power Company, of Hamilton, have surveyors at work taking levels in the vicinity of DeCew Falls, and it is stated that the work of developing the power will be commenced shortly.

The directors of the Hamilton, Grimsby and Beamsville Railway contemplate erecting new stations at Grimsby Park and Beamsville, and will purchase a large new car specially adapted for the summer traffic.

A comparative statement of the Montreal Street Railway earnings for the first five months of the fiscal year has been issued. The total earnings for February were \$8,995.68, an increase of \$2,557.39 over February, 1896.

The town council of Portage la Prairie, Man., lately engaged Mr. J. F. Fanning, of Minneapolis, to report on a slough flooding and water power project. The total cost of the work is placed at \$100,000, including \$15,000 for a power house.

A threatened strike of the employees of the Birmingham, Eng., street railway is reported. This road was recently secured by a syndicate of Canadians, at the head of which is Mr. William McKenzie, of the Toronto Railway Company.

The Toronto Street Railway Company has submitted to the City Engineer its annual statement of rolling stock, etc. There are 221 motors, 180 large trailers, 42 small trailers, 9 sweepers, 12 snow plows, and 40 busses in the car equipment.

The Revelstoke Waterworks, Electric Light and Power Company, of Revelstoke, B. C., is seeking incorporation, to develop light and power. The applicants are John Abraham, Thomas Downs, Wm. M. Brown and Mr. Cowan; capital \$50,000.

The Quebec Electric Railway Company have purchased the rights and privileges of the St. John Street Railway Company and will assume charge on the 1st of May. The company has awarded the contract for trolley cross-arms to J. H. Gignac, for the sum of \$3,500.

Andrew Holland, Thomas Askwith, J. A. Trudeau, and others, of Ottawa, are seeking incorporation as the Dominion Electric

Heating and Supply Company, with a capital stock of \$100,000. The objects are to manufacture electric heaters and other electrical appliances.

Letters of incorporation have been granted to W. Sutton, W. P. Sutton, G. Philip, W. K. Anderson and F. B. Denton, of Toronto, as the William Sutton Compound Company of Toronto, with a capital stock of \$10,000, the object being to manufacture general engineers' supplies.

The Halifax Electric Tramway Company have acquired the entire street railway and electric lighting business of the city of Halifax, N. S. A modern power house has been erected, and the result of the first six months' operation shows gross earnings of \$87,882.23. The assets of the company are valued at \$1,360,000.

The first meeting of the shareholders of the Hamilton, Chedoke and Ancaster Electric Railway was held March 15th. A resolution was passed to obtain the necessary powers from the legislature to extend the road to Brantford and to increase the capital stock. The cost of the extension, it was calculated, would be about \$200,000.

Mr. B. S. Jenkins, superintendent of Canadian Pacific Telegraph, with headquarters at Winnipeg, states that important improvements are contemplated during the coming summer. New wires will be strung from Winnipeg eastward to Fort William; from Winnipeg westward on the main line, and south-west on the Pembina branch.

Incorporation has been granted to the Mineral and Timber Electric Railway Company, to construct an electric railway from Sudbury to Chelmsford, Nipissing, a distance of 20 miles, the work to be commenced within one year and completed within three. Among the promoters are Thos. M. Kirkwood and Killain McKinnon, of Sudbury.

Under the provisions of the General Electric Railway Act of 1895, the running of street cars on Sunday is prohibited, but the courts have held that companies incorporated before that time do not come under the provisions of the Act. The South Essex Electric Railway Company, which proposes to construct an electric railway from Windsor to Sandwich, thence to Amherstburg, Kingsville and Leamington, therefore requested permission from the Ontario government to operate their system on Sunday. The application was, however, refused by the Railway Committee.

The city of Chatham, Ont., is said to have reached an agreement with Mr. L. E. Myers, of Chicago, representing a syndicate of capitalists, for the construction of the Chatham City and Suburban Electric Railway. Mr. Myers agrees to construct a line of railway beginning at Third and King streets, and traversing King, William and Queen streets, to the city limits, thence to Cedar Springs and the lakes, also to install an electric light plant for furnishing electric light for public and private purposes. The lights are to be in operation by 1st September next, and the railway by first January, 1898.

A telephone cable has been laid across the inlet between Moodyville and Vancouver by the New Westminster and Burrard Inlet Telephone Company, under the supervision of Mr. H. W. Kent. The cable crosses the inlet from Hastings to a point directly opposite, and is about a mile in length. For the purpose a scow was fitted up with a reel for paying out the cable. By an ingenious arrangement attached to the cable reel it was possible to communicate by telephone from the cable scow to the shore while the cable was being laid, and thus a thorough test was made of the cable. The time occupied in laying the cable was less than three-quarters of an hour.

The city engineer of Toronto was instructed to report on the merits of the Wilhelm and Strowger automatic telephones, offers having been received to install these systems in Toronto. In this connection he visited several cities in the United States. The Strowger, he says, is a good deal of a novelty, and he watched its operation at Albion, a town where some sixty-four telephones are in use. It is, he says, excellent for a small number of subscribers, but he is not prepared to say whether it would serve the needs of a great city with some 5,000 to 6,000 telephones. There is no operator for the Strowger, but a key-board, with the numbers one to nine and an indicator. To get 234, or any similar combination of numbers, one must set the indicator opposite these numbers. Critics of the system state that it would take some 60,000,000 connecting wires to give a circuit of as many telephones as Toronto would require, and this, it was asserted, would be vastly more costly than operators.

A SHIFTED ECCENTRIC.

BY CAPT. JAMES WRIGHT, Montreal.

SOME time ago an automatic engine in this city that had formerly worked to the satisfaction of all concerned, began to fail, and got worse and worse. The owner rented power to six tenants, each one taking his quota from the main shaft, and the pulleys for the purpose required were sized to agree with an engine speed of 75 revolutions per minute.

It had got so that the engine could not keep up speed if more

shading. This space in the originals was covered with expansion curves impossible to separate.

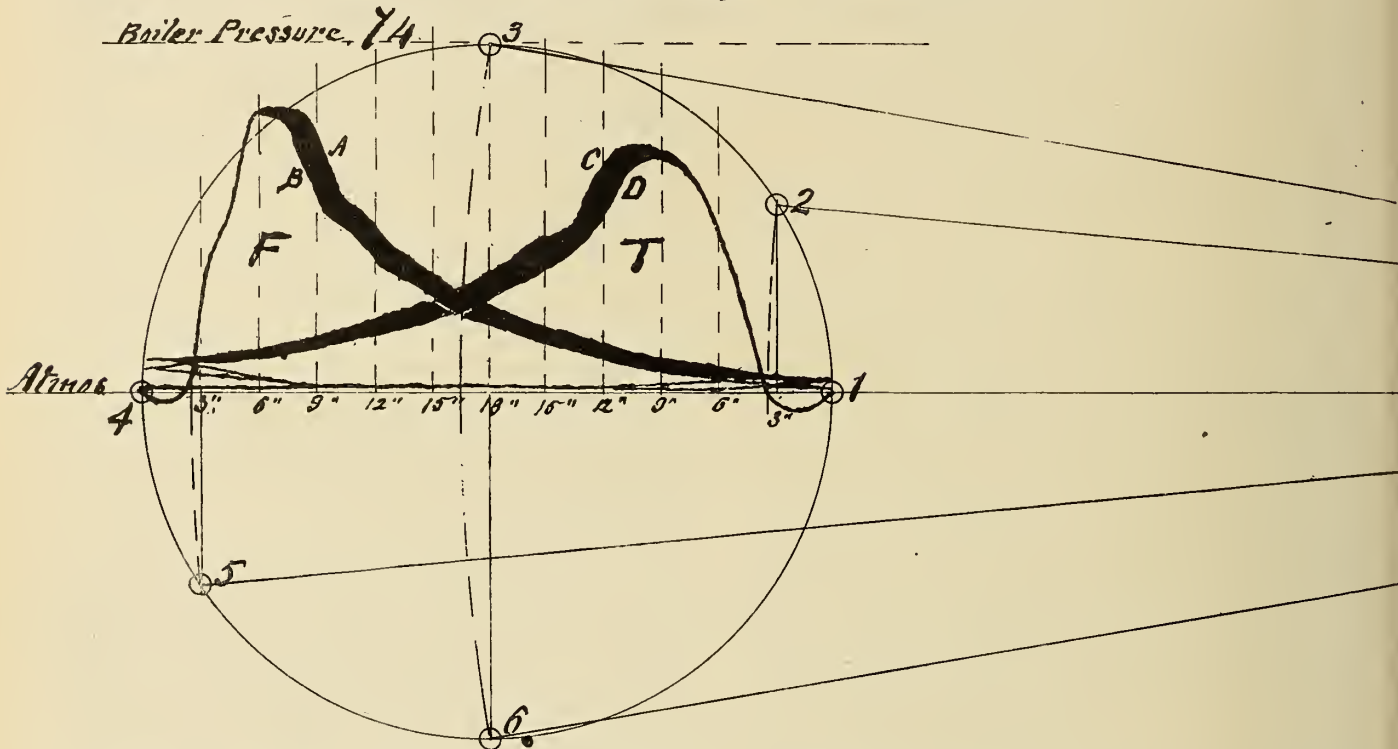
The characteristics of a good diagram from an automatic engine are:

1st. That the admission line from the beginning of the stroke to cut-off should closely approach the boiler pressure.

2nd. That cut-off should be as sudden as possible.

3rd. That at any point in the expansion curve the same weight of steam is practically accounted for.

FIG. 1. First Diagram - 9+30 A.M. Jan, 3rd 1896. Scale 40



than half the work was put on. For a couple of days complaints from the tenants were in order. The owner was willing to do anything required. A man from a shop tinkered the governor; another recommended reboring of the cylinders; an "expert" looked wise and gave a heap of good advice. After all, no improvement had been effected, and tenants said it was going from bad to worse. Some acquaintance of the owner suggested that the indicator should be used. When this had been decided the cylinder was piped in such a manner that indicators at each end of the cylinder could be simultaneously operated. When only one indicator is used on an engine that is subject to great and sudden changes in load, the obtained data may, in many respects, be misleading.

Fig. 1 was the first diagram taken. A glance proves that the eccentric has slipped backward on the shaft.

In taking the accompanying diagrams a patent reducer simultaneously operated the paper barrels of both indicators. It follows, that if the length of the diagrams is divided into any number of equal parts by ordinates or lines drawn perpendicular to the atmospheric line, each division accurately represents, on the reduced scale of the diagram, a uniform amount of travel of the piston while a stroke was being made; and also the effective pressure of the steam on the piston during each division can be read with the scale of the spring in use.

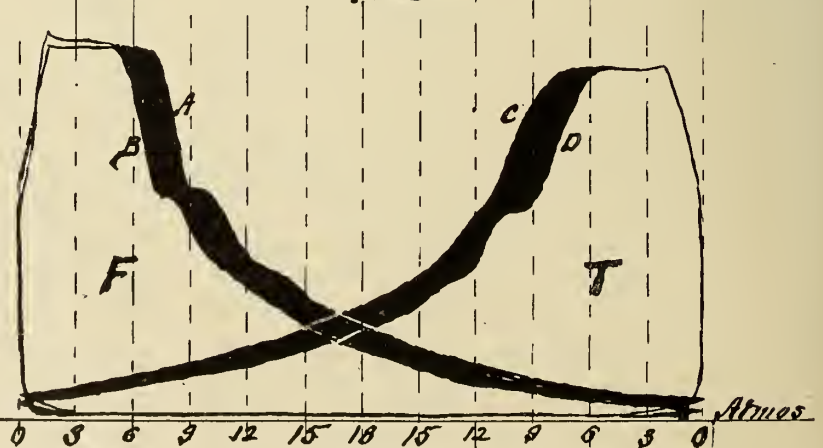
In practice it is convenient to make the number of divisions a multiple of the inches in the stroke—that is a number which divides it without a remainder. In this case there are twelve divisions, and each one equals three inches of the stroke. In all of the figures F is the stroke from the crank and T towards.

In Figs. 1, 2 and 3 the pencil was kept on the paper during 50 revolutions. The variations in work done are shown in dark

4th. Sufficient exhaust lead to permit the cylinder to discharge its contents before, or immediately after the beginning of the return stroke, and followed with a back pressure not exceeding one or two pounds.

5th. Compression or cushioning; this is a debated quantity, but in any case should, at least, be sufficient to prove that the exhaust port had been closed previous to the end of the stroke.

Eccentric moved ahead, 9+53 A.M. Scale 40. FIG. 2.



In diagram T on Fig. 1 the steam stroke begins at the right hand end of the atmospheric line. I read on the diagram that during the first 3½ inches of the stroke the pressure was below the atmospheric. From this point it slowly rises up to 34 pounds at the sixth inch, 51 pounds at the ninth, and 52 pounds at the tenth inch of the stroke, which is the highest attained, and is 22 pounds below the boiler pressure. Complete cut-off takes place at the 12th inch, when expansion sets in and is continued to the end of the stroke with the exhaust port still closed. At the ninth inch of the return or exhaust stroke the back pressure settles down to 1½ pounds. This is carried to the end of the stroke, where there is

no appearance of cushioning. In this manner the other diagrams can be read. The mean indicated work of both strokes is 37 h.p.

Both of these diagrams show that the steam port was slightly open at the fourth inch of the stroke. The engine was stopped and moved into this position. A convenient point of greatest travel in the valve gear was selected, and its distance from a suitable stationary point was accurately measured. The engine was then moved back to the dead centre, or the beginning of the stroke, and the eccentric was turned ahead on the shaft until the valve gear was brought into the same position that it formerly occupied, at the fourth inch of the stroke. The engine was started. Tenants were asked to put on work as they pleased, and the diagrams on Fig. 2 were taken. Here the admission pressure is close to the boiler pressure, and the terminal pressure is about the same as on Fig. 1. Although the work is now 60 h.p., or 23 h. p. greater than in Fig. 1 (the engineer will perceive that the weight of steam accounted for by the indicator is practically the same in both), still the opening of the steam port is slightly late; so is the opening and closing of the exhaust port.

The engine was stopped again, and the eccentric was moved ahead 3-16ths of an inch on the shaft. The tenants were asked to put on all the work they could, and crowd it. The diagrams on Fig. 3 were then taken. During this time the engine worked at an average of 84 h. p. The action of the valve gear is now good, except that steam is carried farther on one stroke than on the other. This was a simple matter to correct, and without stopping the engine. A few minutes before 12 M., and with a falling pressure of steam in the boiler, Fig. 4, a single revolution diagram was taken. This was considered final.

It will be observed in Fig. 3 that in the diagram lettered E E, tripping did not take place. The result is surprising. Compared with the diagram lettered C, which has the greatest charge of steam, the engine could take and trip, the diagram E E accounts for the consumption of 82% more steam and only 18% more work.

The circle and lines on Fig. 1 in conjunction with the stroke scale, is a simple method of representing on a diagram or a sheet of paper, the relative position of a crank pin and piston at any point of the stroke.

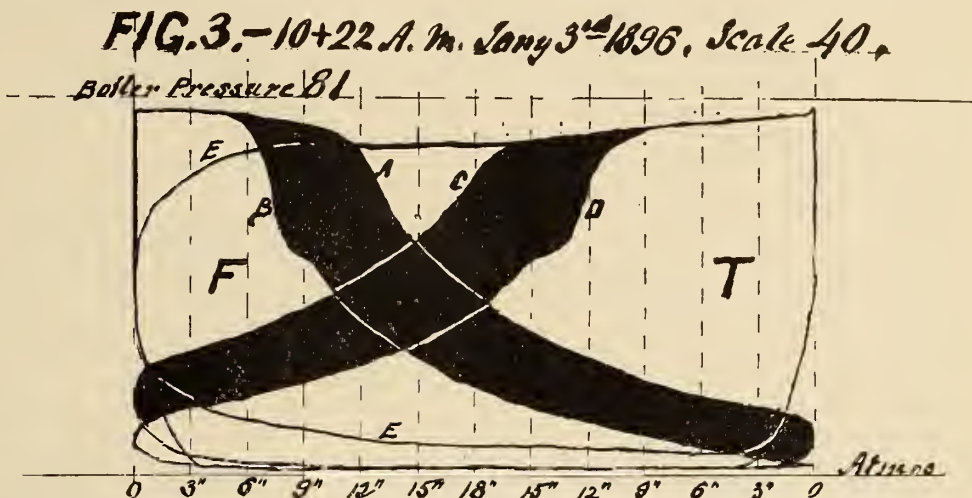
THE STEAM ENGINE INDICATOR.*

By JOHN McEWEN.

The steam engine indicator is an instrument for drawing a diagram, on paper, which will accurately represent the various

their indications were often misleading, and of little use beyond showing the points in the stroke at which the valves opened and closed—a service of great value, but affording only a small part of the information to be gained from a really good instrument.

The Richards Indicator contained many improvements on the instruments previously used. It was well adapted to engines running at the speeds commonly employed at that time; it was invented and was for years the standard indicator in both Europe and America. The weights of the many parts of this instrument are, however, so great that their inertia and momentum seriously affect the accuracy of the diagrams, and render it unfit for use under the conditions of high pressure and high speeds met with in ordinary practice at the present time.



Some of the leading items of information to be obtained by the use of the indicator are: The arrangement of the valves for admission, cut-off, release, and compression of steam; the adequacy of the ports and passages for admission and exhaust, and when applied to the steam chest, the adequacy of the steam pipes; the suitability of the valve motion in point of rapidity at the right time; the quantity of power developed in the cylinder, and the quantity lost in various ways, by wire drawing, by back pressure, by premature release, by maladjustment of valves, leakage, etc. It is useful to designers of steam engines in showing the distribution of horizontal pressure at the crank pin through the momentum and inertia of the reciprocating parts, and the rotative effects around the path of the crank. Taken in combination with measurements of feed water, and the condensation and measurement of the exhaust steam with the amount of fuel used, the indicator furnishes many other items of information relative to the economical generation and use of steam.

The degree of excellence to which steam engines of the present time have attained is due more to the use of the indicator than to any other one thing, as a careful study of the indicator diagrams,

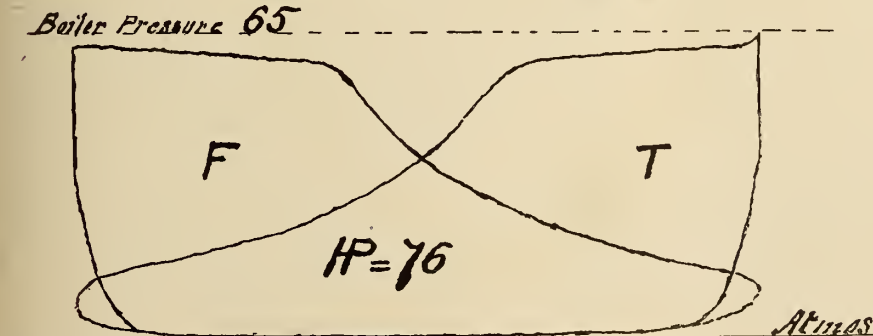
taken under different conditions of load, pressure, etc., is the only means of becoming familiar with the action of steam in an engine, and of gaining a definite knowledge of the various changes of pressure that take place in the cylinder.

An indicator diagram is the result of two movements, viz: a horizontal movement of the paper—and consequently represents by its length the stroke of the engine on a reduced scale—and by its height at any point, the pressure on the piston at a corresponding point on the stroke.

The steam engine indicator has become an appendage to the steam

engine that has been entirely too little understood by the majority of men who follow the profession of steam engineering. Indeed it is not many years since the use of the indicator was considered to belong to a special profession or class of persons, styling themselves "experts," many of whom were not only entirely devoid of any cultivation with reference to the application of the indicator, but were decidedly deficient in their actual knowledge of steam, while some others were well qualified to give honest judgments as to what they found, what they saw, and to indicate, correct, adjust and advise without any sort of reference to their pocket interests. Many of these so-called

FIG. 4. Trip Rods adjusted — 11+50 A. M. Jan'y 3rd 1896. Scale 40.



changes of pressure on the piston of the steam engine during both the forward and return stroke. The indicator was invented by James Watt and was extensively used by him in perfecting his engines. It was a somewhat crude affair as compared with the instruments of the present day, being in design very much like a walking beam engine, the cylinder and piston being at one end of the walking beam and the pencil, with paper drum, at the other.

Of the earlier forms of the indicator it may simply be said that they were unfit for use on an engine running at any but the slowest speeds; even then, owing to their many imperfections,

* Paper read before Kingston Association, No. 10, C.A.S.E.

"experts" persuaded themselves that the working engineer was only a man to shovel coal, or put on grease, oil or slush, as the case might be, and that the "expert" should be called in whenever anything existed that was not up to the mark. But the time for setting the valves of an engine by the eye, or by scratches, or centre punch marks, has, in the opinion of intelligent and competent engineers, passed away, and the engineer of the future will probably be a man who will be capable of a careful manipulation of the indicators, and of producing the highest economic results from following the lines drawn therefrom, without regard to the whims of builder, owner or others, being himself qualified to read the lines, and make them by the proper manipulation of the instrument.

WHEN AND HOW TO ATTACH THE INDICATOR.

There is always a clearance in every engine. This is the space between the piston at the extreme end of the stroke and the cylinder covers. There is quite a difference in the amount of clearance allowed by builders, but now all first-class builders have reduced the space to a minimum—as little as 5 to 8%—as this space has to be filled with steam twice during each stroke in a fast-running engine, it soon foots up to quite a sum of money in fuel; in fact, I know of one engine, the cylinders of which were 24" diam. and intended for 24" stroke, but it was found that the cranks, if they were 11" would not clear in the foundation plate, so they were made 10 $\frac{3}{4}$ ", making the stroke 21 $\frac{1}{2}$ "; the pistons and covers were left as originally intended. As a consequence the owners became bankrupt. The vessel was sold to another company, who put in new boilers, ran her on a good paying route for a few years, then had the good fortune to convert the engines into a compound, when the fuel was reduced from 110 tons per week to 49 tons; of course the compound got the credit.

But this is a digression. The proper place to put the connections for indicator is in the clearance space, so that the pistons will not at any time even partially cover the hole. If there is not $\frac{1}{2}$ " clearance the hole should be drilled towards the cover and a groove cut in the cover to suit. To indicate an engine properly, so as to be able to give a correct report, it is necessary to know what is the total amount of clearance, including the ports. As this space has to be filled with a volume of steam twice during every revolution, if clearance is too great there will be great difference in the reading of the diagram. After the diagram has been traced by the instrument, it is necessary, when trying to get at the economic result, to erect the volume of clearance on the card. Some engines will take a beautiful card, but when the volume of clearance is added it looks very different. This often occurs in the marine walking beam engines with the Stevens cut-off.

In putting on the indicators it is best to have two instruments—one at each end of the cylinder—and have them both taken at once. The usual connections of a side pipe with a T or three-way valve in the middle, and taking both ends on the same card, may do very well for a short-stroke, slow-moving engine, but under any other conditions may be the source of error to a large extent, so it is much better practice to take the diagrams as already mentioned with two indicators simultaneously.

The next thing is a good reducing motion; one of the best is the Brumbo pulley; another good device is the Pantograph, which, if properly made and used, is scientifically correct. With the Brumbo pulley the line may be used at an angle, but with all other devices the line must run at true right angles. These conditions being complied with, you may put on your indicator and connect the cord so that the drum of the instrument works in the centre of motion; then warm up the indicators by turning on the steam, and after the water is all blown out, press the pencil lightly to the card, taking care to let the pencil go but once around the figure, then turn off steam and press the pencil again to the card and mark the atmospheric line, and your diagram is complete as far as the indicator can make it. The knowledge of the operator has now to be brought into use.

The British Columbia Light and Power Company has been organized and seeks authority from the provincial government to supply electric light and power to the towns of Trail and Rossland. Among the promoters are Messrs. W. S. Norman, of Rossland, and Wm. Archer, of New York. The syndicate have already spent \$100,000 in putting in turbine wheels, flumes, etc., in connection with placer mining on the Pend Oreille river, near Waneta, B. C., and have 3,000 horse power at their command. They wish to increase their capital to \$1,000,000, and to transmit 15,500 horse power over a distance of 17 miles to Rossland and Trail.

TRADE NOTES.

The contract for additional motors for the St. John Railway Company has been placed with Ahearn & Soper, of Ottawa. The equipments will be of the Westinghouse 12-A type.

The Packard Electric Co., Ltd., of St. Catharines, Ont., have notified their customers that their factory will be closed down during the first two weeks of April on account of unwatering of the Welland canal.

Pulp mills in New York, Massachusetts, Maine and New Hampshire are receiving large quantities of their raw material from Canada in the form of spruce logs. The middlemen who buy the wood from Canadian farmers and lumbermen and deliver them to the pulp mills on the other side of the line make a handsome profit. What is the matter with Canadians working their own pulp wood in their own country? The Robb Engineering Company, of Amherst, N. S., are now making a full line of pulp machinery.

The Northey Manufacturing Co., Toronto, the well known makers of steam pumps, have in course of construction a new building, to be used as a foundry. It is the intention of the company to in future make their own castings, and for this purpose the new building is being equipped with the latest type of eupola, tramways and cranes for the easy handling of iron and heavy castings, etc. A Robb-Armstrong engine has been purchased for the special purpose of operating the fans, which will supply the air blast to the cupola. The company have also about completed patterns for a 10 h. p. oil engine, and it is their intention to manufacture these engines in all required sizes.

A correspondent writes from Toronto Junction to the Toronto World as follows: The Dodge Pulley Company's works at Toronto Junction are running fifteen hours per day, with a full complement of men. The company tell us that never in the history of their eleven years' business in the Dominion have they been so crowded with work. The manufacture of their celebrated wood split pulley is constantly increasing. Recent large shipments have been made to Madras, India, and to agencies in Central America. While the order alone for over 1000 pulleys is at present being prepared for shipment for the English market. In addition to the manufacture of wood split pulleys, the Dodge Company are also general machinists and millwrights, and have now in work complete power transmission plants for several electric stations, including shafting, floor stands, friction clutch pulleys, bearings, heavy iron centre driving pulleys, etc. The Dodge Company are also doing a lot of special work for some of our largest mining plants. In the company's machine shop at present are sixteen friction clutches in work for contracts on hand.

It is stated that Mr. H. J. Beemer, who was instrumental in securing a charter for the Quebec electric street railway, will construct an electric railway between St. Joseph de Levis and Chaudiere, Que.

A bitter legal suit is likely to be the result of the competition for lighting patronage between the Ottawa Electric Co. and the Hull Electric Co. The Hull Electric Company has served the Ottawa Electric Company with notice of a claim for twenty thousand dollars damages for infringement upon the territory and rights of the Hull company in the city of Hull. In default of payment an action will be entered in the Superior court to recover the amount. The Hull Electric Co. claim that, according to a special act of the Quebec legislature, the exclusive privilege for supplying light for a period of 35 years from May, 1894, was granted to Mr. Viau. The Ottawa company, in addition to the payment of \$20,000, are requested to remove their poles, electric apparatus and appliances from the streets.

Representatives of the Canadian General Electric Company, Toronto and Peterboro, appeared before the Tariff Commissioners at Ottawa last month. They pointed out that they paid higher duties on their imported raw material, which constituted 75 per cent. of the finished machine, than the duty which is charged upon their finished article when imported, and consequently they had no protection. If there was a reduction of duty on the imported article, they desired a corresponding reduction on their raw material. The chief articles imported were steel castings, copper, charcoal, sheet iron, fine linen, certain varnishes, press board, parchment papers, silver tubing special tinned steel wire, German silver wire, music wire, all of which were not made in Canada.

PUMPING ENGINE TESTS AT PETROLEA, ONT.

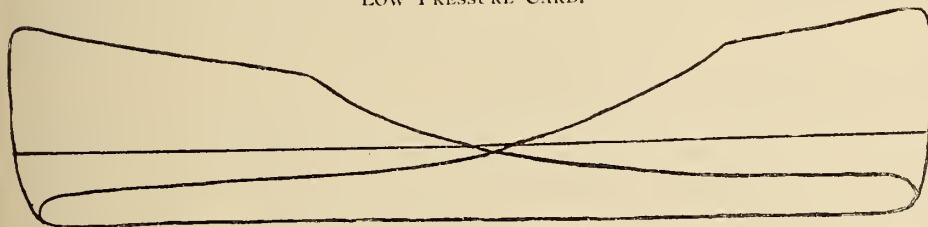
IN connection with the new waterworks system recently constructed for the town of Petrolea, Ont., under the direction of Mr. Willis Chipman, C. E., of Toronto, there have been installed two pumping engines—one a high duty—the other a medium duty

CARDS FROM HIGH PRESSURE CYLINDER OF HIGH DUTY ENGINE.
Scale 1/80.



Diameter of Cylinder, 13 inches. Stroke, 32 inches. Piston Rod, $2\frac{1}{4}$ inches. Pressure by Steam Gauge or Boiler, 125 lbs. Vacuum by Gauge, 25.3. Revolutions, 50 per minute. M. E. P., 51.5. I. H. P., 59.4.

LOW PRESSURE CARD.



Cards from Low Pressure Cylinder.

Cylinder, 26 inches by 32 inches. Piston Rod 2.5. Boiler Pressure, 124 lbs. Vacuum, 25 inches. Revolutions, 50 per minute. M. E. P., 14.2. I. H. P., 60.59. Temperature of Feed, 115. Scale of Card 1/32. Receiver Pressure, 32 lbs.

duplex. The contract for these engines was given to the Hughes Steam Pump Company, of Cleveland, who sub-let to the London (Ont.) Machine and Tool Works a contract for the construction of the high duty engine, in order that the whole contract might be completed within the specified time. The general specifications for these engines were drawn by Mr. Chipman, and gave the size of cylinders, plungers, valves and connecting pipes, and the general arrangement of the plant. Each engine was to have a capacity of 1,000,000 imperial gallons in 24 hours, against a head of 485 feet, and the specifications were so drawn that for each million ft. lbs. that the duty fell short of 100,000,000, the sum of one hundred dollars was to be deducted from the contract price. The duty was to be calculated from the amount of coal used, no deduction being made for ashes, and from feed water at 180°.

A ten hours test of the high duty engine was made on the 4th and 5th of February by Messrs. Willis Chipman, C. E., and J. H. Killey, of Hamilton, on behalf of the municipality and the manufacturers respectively.

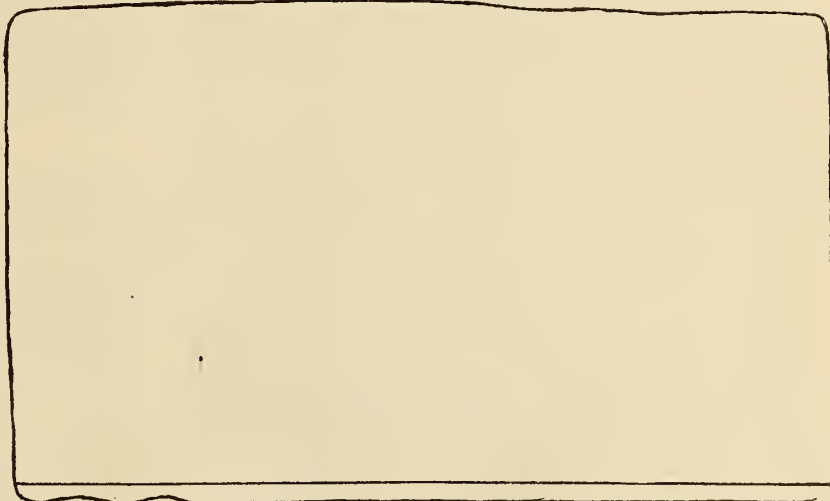
There was considerable difference of opinion on the part of Mr. Chipman and Mr. Killey as to the result, the former placing the duty obtained at 95,000,000, and the latter at 103,798,200. It was agreed therefore, that a second test should be made, which was conducted by Mr. Chipman alone, in the presence of Mr. Yates, of the London Machine and Tool Works and Mr. Hughes,

of the Cleveland Company. The test, as in the former instance, occupied ten hours. The engine was run at $52\frac{3}{4}$ rev. per m.; water pressure, 200 lbs. to the sq. in.; steam pressure, 125 lbs. to the sq. inch; intermediate cylinders, 16 lbs. to sq. in.; vacuum 24; vertical distance from gauges to water in well, 14 feet; feed water used, 360 cubic feet at 110°; coal consumed, 2430 lbs.; ashes,

120 lbs.; temperature flue gases, 220°. As mentioned above the duty was calculated from the amount of coal used, with no deduction for ashes, and from feed water at 180°. The result was a duty of 98,500,000. This duty is stated by the gentlemen who conducted these tests to be considerably higher than that shown by any other pumping engines of similar size in Canada, and the engine and pumps are said to have worked well under nearly double the head of water of any waterworks engine in the Dominion, while the boilers are said to have steamed freely without forcing. The boilers are of the horizontal tubular type, set in brick work, externally fired. The gases of combustion pass under the shells and

return through the tubes and through two uptakes through a horizontal pipe flue to the brick chimney outside of the building. The accompanying indicator cards, taken at the first test, show how perfect was the

CARD FROM PUMP CYLINDERS.



Diameter of Pump Plungers, $6\frac{1}{2}$. Stroke, 32 inches. Piston Rod, 2 inches. Revolutions, 50 per minute. Lift by Suction, 12 feet. Indicator connected with pump band by a short $\frac{1}{2}$ inch pipe having an angle; full way valve as well as indicator was wide open on test. Scale of card, 1/80. Area of Plunger, with one half the rod off, 31.61. The total lift not shown on steam gauge, including friction of suction pipe, pump, and valves, 20.5 feet.

action of the engine. The guaranteed capacity of the duplex engine was 50,000,000, and the result of the test gave a duty of 53,000,000.

Mr. Ross has introduced a bill in the Ontario legislature providing that a high school board may, by resolution, establish a technical school, and any high school already established may be changed into a technical school.

ELECTRIC RAILWAY DEPARTMENT.

DECISION RELATING TO SUNDAY CARS.

In the Court of Appeal at Toronto judgment was recently given in the case of the Attorney-General of Ontario vs. Hamilton Street Railway Company, dismissing the plaintiff's appeal against the decision of Judge Rose declaring the street railway company within its rights in running street cars on Sunday. The text of the judgment delivered by Chief Justice Burton is as follows:

This is an appeal from a judgment of Mr. Justice Rose holding that the defendant company, which own and operate a street railway in the city of Hamilton, do not come within the meaning of the words, "or other persons whatsoever," as found in the first section of what is generally known as the Lord's Day Act, originally passed in 1845, and entitled "An act to prevent the profanation of the Lord's day, commonly called Sunday," and now to be found in the revised statutes, cap. 202.

Unfortunately the decisions in England under the statute of 29, Charles the Second, for a similar purpose, afford us but little assistance in the construction of our own statute. Had the language of our statute followed precisely sec. 5 of the statute of Charles, this question would have been free from doubt, and the decision in *Sandiman vs. Breach* decided in England in 1827, and the reasoning of that judgment, which is in conformity with a long course of decisions, would show that the maxim of ejusdem generis would clearly apply.

Our legislature did not, however, adopt that section, but after adding "merchant" to the enumerated persons who are forbidden to do or exercise any worldly labor, business or work of their respective ordinary callings upon the Lord's day, makes this exception, (conveying travellers or Her Majesty's mail by land or water, selling drugs and medicines, and such other works of necessity only excepted.)

Now this exception was clearly unnecessary as regards the persons specifically enumerated. No one would expect the carrying of travellers or conveying Her Majesty's mail to fall within the ordinary work or calling of a merchant, tradesman, artificer, mechanic, workman or laborer, and counsel for the appellant therefore contended that a wider construction should be given to the words "other persons whatsoever" than they should receive if they were found in connection with the specific persons named without other qualifications. There is much force in the contention, and I was at first inclined to think that in order to make the whole section consistent and intelligible the words should receive a wider construction and apply to all persons, including corporations, having an ordinary calling. I am satisfied, however, upon further consideration, that we cannot concur in such a conclusion without in effect overruling a line of decisions which have prevailed in the courts for over a century.

It must be borne in mind that the legislature must be presumed to have been aware of this line of decisions when they passed the 8th Vict., and if they then intended to embrace every description of persons and every species of business, in the ordinary calling of such persons, it would not have been necessary still to retain the specific enumeration of several classes of persons exercising particular descriptions of labor or business similar to those enumerated in the statute of Charles. It would have been sufficient to say in general terms that no person whatsoever should do any work or business in his ordinary calling on the Lord's day. But this is made more clear when we find that the legislature did decide to add to the enumerated classes merchants. Here again the object could have been attained by striking out the enumerated classes and extending the section to all persons, but when we find them adding "merchant" by that description to the other enumerated classes, followed by the words in question, it leads, I think, to the irresistible conclusion that a merchant would not be included in the words "or any other persons whatsoever," but that those words must, according to the general rule, that preceding particular words, control subsequent general words, be construed to mean persons ejusdem generis with those already mentioned, all of whom exercised an ordinary calling, and that if a carrier, and perhaps a fortiori a corporation, carrying on a business of a carrier of passengers, were intended to be included in the prohibition, they would have been specially mentioned in the same way as a merchant has been mentioned.

It is not within our province to determine the wisdom or expediency of the law, and although it may in the opinion of many persons be considered desirable that other secular concerns besides those expressly mentioned in the statute should be comprehended in it, we must be careful not to extend the words of the statute beyond their natural import; to do so would be to legislate and not to interpret the law as we find it.

It may be that the legislature may consider it desirable that all persons doing an ordinary calling shall not do any labor, business or work at that ordinary calling on Sunday; if so, it is easy for them so to declare. But this a penal enactment, and any infraction of it subjects the party infringing it to a penalty. We ought not therefore to hold any party within the first section unless it is clear to our minds beyond any reasonable doubt that he is intended to be included. But the Act contains internal evidence that was not intended to include corporations, for in the 14th section, dealing with penalties, it is provided that the party offending may, by default of payment of the fine imposed, be

committed to the common jail for any term not exceeding three months, and the form of conviction in the schedule to the Act is to the same effect.

I think it impossible therefore to hold that the learned judge was wrong when he held that the defendants were not within the words "other persons whatsoever."

This renders it unnecessary to decide the meaning of the word "travellers," as found in this Act. I think it worse than useless to refer to the interpretation of the word as found in the decisions in England under the Ale House Acts. Those acts were passed "alio intenter," and can afford us no assistance in arriving at the meaning to be attributed to the word under our statute.

I think finding the word in connection with the carrying of the royal mail and described as *inter alia*, a work of necessity, there ought to be no difficulty in ascertaining what was intended. I agree with so much of the judgment pronounced so many years ago by Sir John Robinson, delivering the decision of the Court or Queen's Bench, as defines the work travellers as used in the Act, and I think it sound law to-day as it was then.

Opinions may differ as to these statutes, some being of opinion that the statute of Charles is wholly unsuited to the present age, whilst others are of opinion that our act is "a useful and salutary enactment." But we cannot overlook the fact that in the time of Charles travelling upon Sunday was illegal, so that there could be no recovery from any injury sustained in the course of the journey. And although our act is not so stringent in its provisions, still its promoters had in view the prevention of what they deemed as profanation of the Lord's day, and excepted only such conveying of travellers as came within the meaning of a work of necessity.

How any one could hold that excursionists either to the Island or anywhere else came within the definition of "travellers" within the meaning of the framers of our own act (to use the very expressive but not perhaps very judicial language of Lord Bramwell) "beats me."

It was said in the case in which that was so held that Regina vs. Tinning was decided before the subsequent cases which are referred to in that judgment.

The application of cases decided under the English Ale House Acts to an act of this nature is most misleading, but none of them in the slightest degree conflict with the judgment of Sir John Robinson in Regina vs. Tinning, and obviously have no bearing in construing the exception of what is regarded as a work of necessity in the present Act, passed for the purpose of preventing what in the opinion of its framers was regarded as a desecration of the Sabbath. I am of opinion, therefore, that the appeal should be dismissed and the judgment below approved.

The court was unanimous.

Mr. Justice Osler concurred in the judgment of the Acting Chief Justice, but said that he did not desire to give any opinion as to the meaning of the words "conveying travellers." Mr. Justice Maclellan also concurred, but based his judgment entirely upon the ground that the Lord's Day Act was not intended to include and could not be made applicable to any corporation.

SPARKS.

A company will, it is said, undertake the construction of an electric railway between St. Johns, Longueuil and St. Lambert, Que.

The Hamilton Radial Railway Company propose to extend its Beach line to the easterly limits of Burlington, and establish there a park and pleasure grounds.

The Hamilton, Chedoke and Ancaster Electric Railway Company will shortly let the contract for the construction of their road from the corner of Herkimer and Hess streets to Chedoke.

The Kingston Street Railway Co. will make several improvements to their line, including its extension to the depot. New motors will be secured for the cars running to Portsmouth, to provide a faster service.

The Railway Committee of the Ontario legislature have passed the bill to incorporate the Ingersoll Radial Railway Company, which proposes to construct electric roads to St. Marys, Tilsonburg, Brownsville, etc.

The Railway Committee of the Ontario parliament have passed the act incorporating the Lanark County Electric Railway Company, to construct a railway from Perth to Lanark, with branches. The promoters are: Alex. H. Edwards, Carleton Place; John B. Riley, Plattsburg, N. Y.; Thomas Henry, Montreal; James Fowler, Arnprior; George A. Fowler and J. A. Houston, Ottawa.

McKain vs. Ottawa Electric Railway Co. is a suit brought by the former, a property owner on Cedar street, claiming that as the result of the change in the grade of the street made by the Ottawa Electric Company, his property has been depreciated in value to the extent of \$1,500. The company claim, on the other hand, that any damage sustained in that way is counterbalanced by the proximity of a line of street railway, and also, having authority from the corporation of Hintonburgh to use the street, they were not directly responsible. A decision has not yet been given.

THE METROPOLITAN STREET RAILWAY COMPANY.

At the present session of the Ontario legislature the Metropolitan Street Railway Company sought several amendments to its charter. Permission was asked to extend its line to Lake Simcoe; to acquire the assets and franchise of the Toronto Suburban Street Railway Company; to operate its cars over the tracks of the Toronto Railway Company to the Union Station, and to supply electric power in Toronto and elsewhere. In the Railway Committee of the House the application to extend the road to Lake Simcoe and to purchase the Toronto Suburban Street Railway Company's franchise was granted. The scheme is to run a line parallel to the present road, touching Lake Simcoe at Jackson's Point, and passing through Weston, Woodbridge, Kleinburg and Schomberg, to Alliston and other points. Permission was refused to use the tracks of the Toronto Railway Company for conveying passengers to the Union Station, and the clause asking authority to distribute light and power was opposed on behalf of the Toronto Electric Light Company. It was conceded by the Metropolitan Company that the right to sell light and power in Toronto would not be asked, and in return the privileges for the counties of York and Simcoe were granted.

MOONLIGHT SCHEDULE FOR MARCH.

Day of Month.	Light.	Extinguish.	No. of Hours.
	H.M.	H.M.	H.M.
1.....	P. M. 6.50	A. M. 5.30	10.40
2.....	" 6.50	" 5.00	10.10
3.....	" 7.10	" 4.50	9.40
4.....	" 8.00	" 4.50	8.50
5.....	" 9.00	" 4.50	7.50
6.....	" 10.10	" 4.50	6.40
7.....	" 11.20	" 4.50	5.30
8.....	.....	" 4.50	.....
9.....	A.M. 12.10	.....	4.40
10.....	" 12.50	A. M. 4.40	3.50
11.....	" 1.20	" 4.40	3.20
12.....	" 1.50	" 4.40	2.50
13.....	" 2.20	" 4.40	2.20
14.....	No light.	No light.	....
15.....	No light.	No light.	....
16.....	No light.	No light.	....
17.....	No light.	No light.	....
18.....	P. M. 7.10	P. M. 9.40	2.30
19.....	" 7.10	" 10.40	3.30
20.....	" 7.10	" 12.00	4.50
21.....	" 7.10	" 1.00	5.50
22.....	" 7.10	" 1.40	6.30
23.....	" 7.10	" 2.10	7.00
24.....	" 7.10	" 2.40	7.30
25.....	" 7.10	" 3.10	8.00
26.....	" 7.20	" 3.30	8.10
27.....	" 7.20	" 3.50	8.30
28.....	" 7.20	" 4.10	8.50
29.....	" 7.20	" 4.10	8.50
30.....	" 7.20	" 4.10	8.50
31.....	.....	.....	.....
Total,			165.10

ROBERT A. ROSS, E.E.

(M. E. Graduate S.P.S.—E. E. Degree
Toronto University.—Mem. A.I.E.E.)

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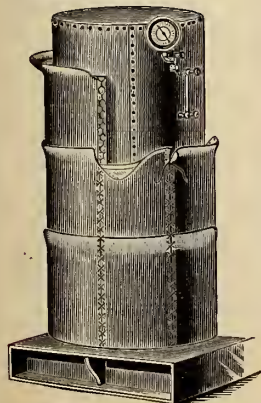
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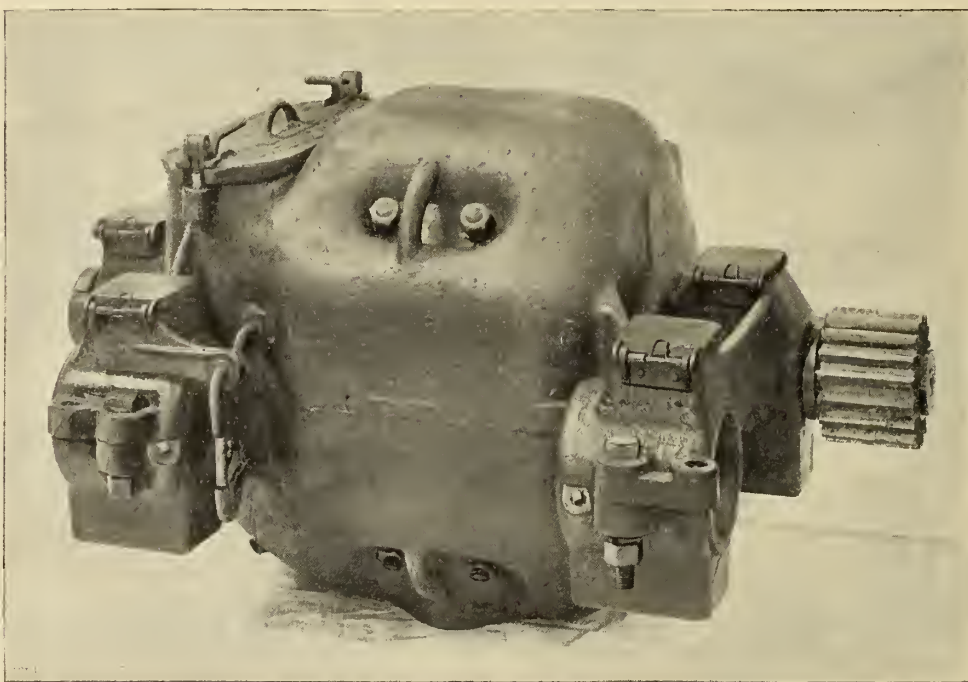
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C.G.E. 1,200
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Cornwall Street Railway.
Kingston, Portsmouth & Cataraqui Rail-
way.
Belleville Traction Company.
Peterborough & Ashburnham Electric Street
Railway.
Toronto Railway.
Metropolitan Street Railway.
Toronto & Scarboro Electric Railway.
Toronto & Mimico Electric Railway.

Toronto Suburban Street Railway.
Hamilton Street Railway.
Hamilton Radial Electric Railway.
Port Dalhousie, St. Catharines & Thorold
Street Railway.
Niagara Falls Park & River Railway.
Guelph Street Railway.
Berlin & Waterloo Street Railway.
Galt, Preston & Hespeler Railway.
Brantford Street Railway.
London Street Railway.
Port Arthur Street Railway.
Winnipeg Electric Street Railway.
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Consolidated Railway, New Westminster,
B. C.
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A. SANGSTER,
SUPERINTENDENT.

Sherbrooke, Que.,
CANADA.

Feb 9th 1897

messrs The Royal Electric Co
Montreal

Gentlemen

We have tried the 180 K.w. Generator, with what we consider a good fair load. or perhaps a little more than fair, we had 50 Amps on one side for Sherbrooke, and 30 Amps on the other side for Lemmerville. We had the voltage 10 volts higher on the Lemmerville line. I must say it does more and better than I could imagine. The bearings of the machine were as cool this morning as when we had run one hour. And the lights did not seem to vary in the slightest, you see we had every confidence in your work and machine, and put the extremes on, you should have seen how pleased the men were when they saw how steady the voltage kept on the two different lines, when we get the new Exciter on. it will be better. I thank your Mr. Brown for coming for coming out, and giving us so much good advice, which will be carried out.

Yours respectfully

A. Sangster
Supt

Our Patrons are our Best References

Our Plants Speak for Themselves

A FROLIC OF ELECTRICITY.

A Volt was going along the wire one day,
And met a little Ohm,
"You will meet with more resistance, sir,
You had better stay at home."

But the Volt went on with lightning speed,
Not showing any fear,
Until it overtook upon the wire
A lively, hot Ampere.

"There's going to be some trouble, sir,
A ground is on the line.
And circuit-breakers are ahead,
You had better drop behind."

A flash of fire flew from the Volt,
That made the air look blue;
This made the ampere hotter still,
As through the wire it flew.

It jumped across a little gap,
And to the pole on top,
Then to the earth it glided down;
But there it did not stop.

Back to the power-house it went,
This alternating scamp,
And gave the switch-board man a shock
That made his muscles cramp.

The brushes snapped and flashed and cracked.
The Ampere meter cursed.
The rheostat began to smoke,
The pilot lamp then burst.

The penstock inlet gate was closed,
And all the turbines stopped.
The dynamos then ceased to turn,
The circuit switches dropped.

The ground was taken from the line,
The "juice" turned on the bars.
The rampant Volt that caused the hitch,
Once more is running cars.

Edward Jabez Lamphere.

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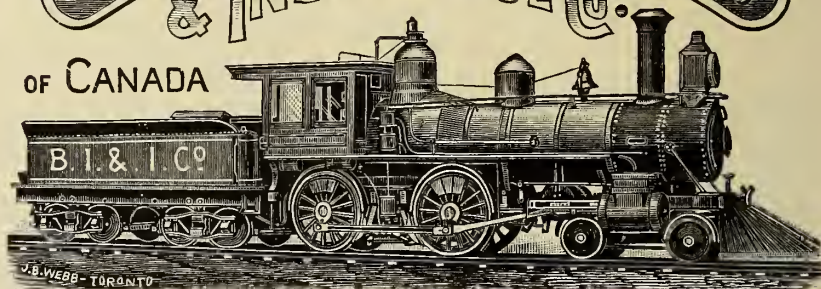


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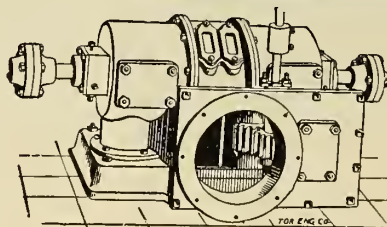


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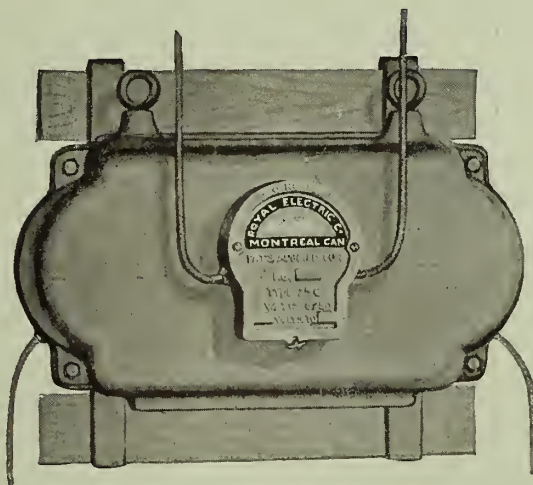
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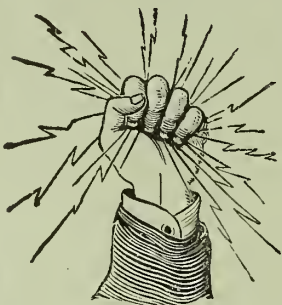
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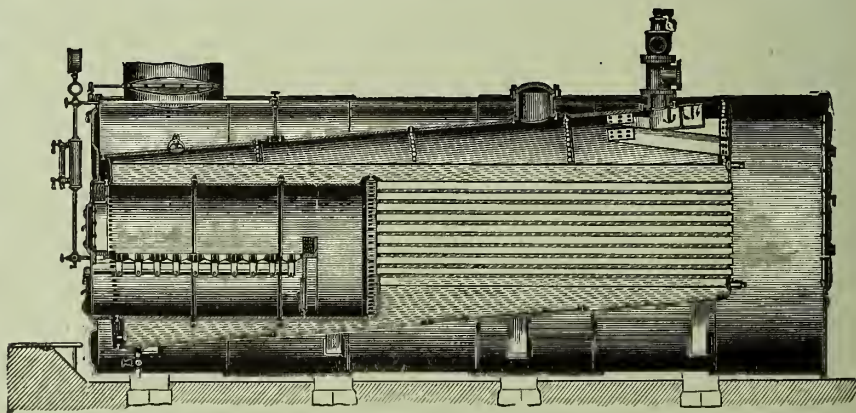


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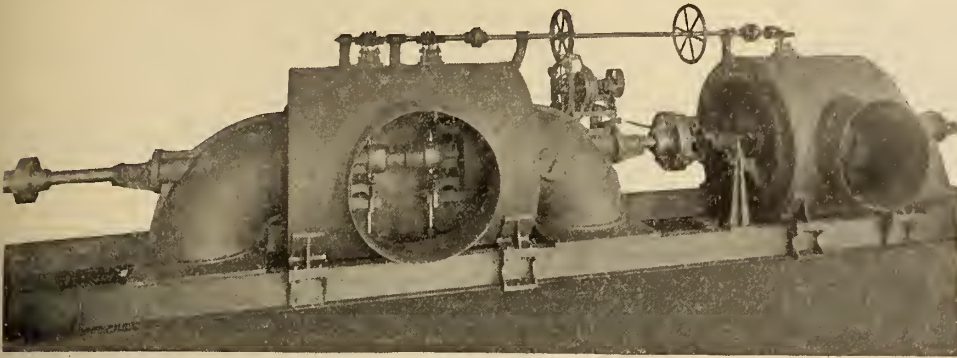
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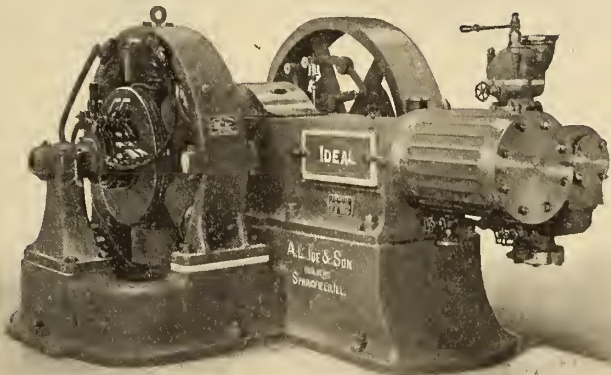
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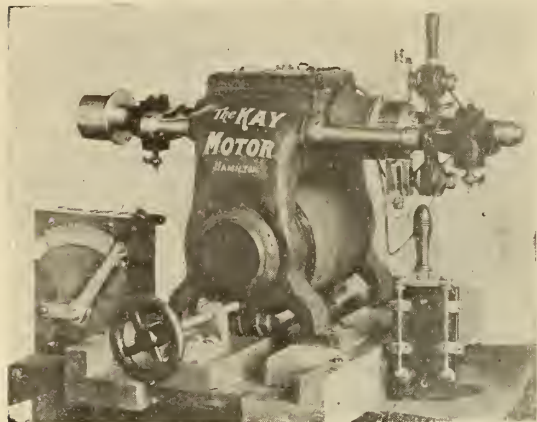
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CANADIAN
ELECTRICAL NEWS
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VOL. VII.

MAY, 1897

No. 5.

CANADIAN ELECTRICAL ASSOCIATION
CONVENTION.



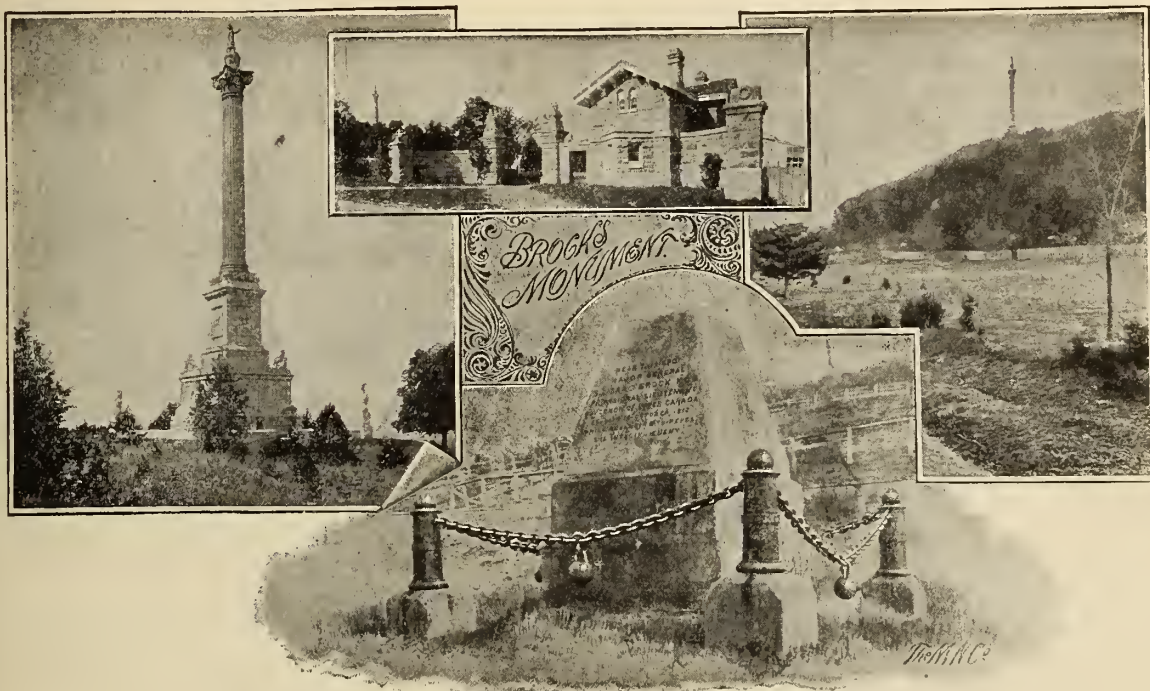
ARRANGEMENTS for the approaching Convention of the Canadian Electrical Association at Niagara Falls, Ont., are so far completed that we are able to present on this page a copy of the programme which has been arranged for the occasion. A

brief study of the programme will suffice to show that the coming convention is likely, from every point

LIST OF PAPERS.

- "Day Loads for Central Stations and How to Increase Them." J. A. Kammerer, Toronto.
 "Submarine Cables—Dealing more especially with the Actual Experience in Cable-Laying and Maintenance in this Country." D. H. Keeley, Ottawa.
 "Determination of the Heating Power and Steam Producing Value of Coal from a Preliminary Examination." Wm. Thompson, Montreal.
 "Water-Driven Plants." John Murphy, Ottawa.
 "The Commercial Aspect of Electric Railways." C. E. A. Carr, London, Ont.
 "Accumulators: Their Application to Central Station Lighting and Power." W. A. Johnson, Toronto.
 "Why Some Lighting Plants do not Pay." F. C. Armstrong, Toronto.
 "Steam End of an Electric Plant." A. M. Wickens, Toronto.

NOTE—It is proposed to introduce at this Convention a Question Drawer. Members are invited to forward questions to the Secretary prior to May 22nd, and an effort will be made to furnish satisfactory answers at the Convention.



VIEWS AT QUEENSTON HEIGHTS.

of view, to be one of the most interesting in the history of the organization, if indeed it does not surpass any that has preceded it.

CONVENTION HALL—DUFFERIN CAFE', QUEEN VICTORIA PARK, NIAGARA FALLS, ONT.

BUSINESS PROGRAMME.

WEDNESDAY, JUNE 2ND.

- 2.00 P.M. Opening of first session in Convention Hall, Dufferin Cafe', Queen Victoria Park.
 President's Address.
 Reading Minutes of last Meeting.
 Secretary-Treasurer's Report.
 Reports of Committees.
 General Business.
 Presentation of Papers.
 Discussion.

THURSDAY, JUNE 3RD.

- 9.00 A.M. Consideration of Reports of Committees.
 Election of Standing Committees.
 Selection of Place and Time of next Meeting.
 Election of Officers and Executive Committee.
 General Business.
 Presentation of Papers.
 Discussion.

SOCIAL FEATURES.

WEDNESDAY, JUNE 2ND.

- 7.00 p.m.—By special invitation of the management of the Buffalo and Niagara Falls Electric Railway Co., an Excursion by special electric cars from Niagara Falls, N.Y., to Buffalo. Visit of inspection to Buffalo Railway Power House. Returning, reach Niagara Falls about 11 p.m. By courtesy of the Suspension Bridge Co., members taking part in this Excursion will be permitted to cross the Suspension Bridge in both directions without charge.

THURSDAY, JUNE 3RD.

- 8.00 p.m.—Annual Banquet at Dufferin Cafe'.

FRIDAY, JUNE 4TH.

- By courtesy of the undermentioned companies, the following programme has been arranged:—
 9.00 a.m.—Special car will leave Hotel Lafayette for a trip over the Niagara Falls Park and River Railway to Queenston.
 9.45 a.m.—Cross Niagara River by Niagara Navigation Company's Steamer to Lewiston, N. Y.
 10.00 a.m.—Leave Lewiston by special cars on the celebrated Gorge Electric Railway, reaching Niagara Falls at 10.45.
 11.00 a.m.—Visit of inspection to Hydraulic Power House.
 11.30 a.m.—Descend by Incline Railway and take steamer "Maid of the Mist" for a trip to the foot of the Cataract, landing on Canadian side.
 1.30 p.m.—Cross Suspension Bridge.
 2.00 p.m.—Inspection of the Power House and Works of the Cataract Construction Co.
 3.00 p.m.—Visits to various Electro-Chemical Works.

STEAMBOAT AND HOTEL ARRANGEMENTS.

The Association are indebted to the Management of the Niagara Falls Park and River Railway Co., and the Niagara Falls and Suspension Bridge Railway Co., for having kindly tendered the freedom of their respective roads to the members of the Association during the Convention.

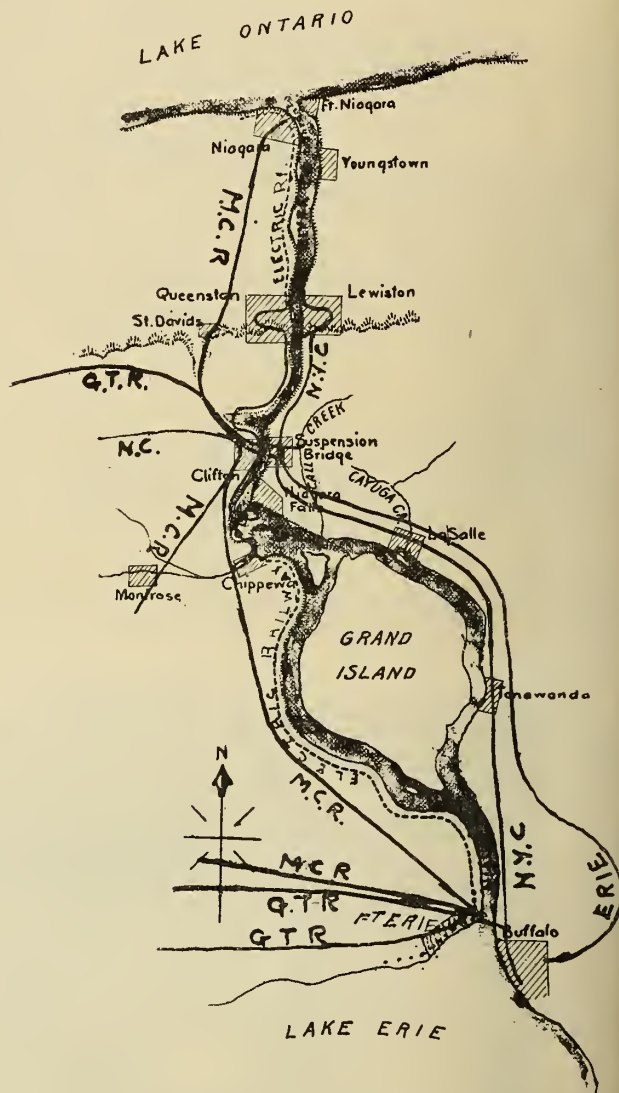
The Niagara Navigation Co. offer a reduced rate of \$1.25 from Toronto to Niagara and return to members and their friends on presentation of certificates signed by the Secretary.

The Hotel Lafayette, situated opposite the Upper Suspension Bridge, offers a special rate of \$2.00 per day to members and friends of the Association in attendance on the Convention.

A great transformation has taken place in the vicinity of Niagara Falls in recent years, and persons who may not have visited the locality will find much that is new, interesting and instructive. For the benefit of those who may not be familiar with the locality, especially since these changes were effected, we present in the accompanying views some of the points of greatest interest, but, as will be seen by reference to the programme, there are many others on both sides of the river, which will be visited, and which are calculated to please and instruct the beholder.

In accordance with a suggestion made by Lord Dufferin the legislatures of the State of New York and the Province of Ontario, acting in concert, upwards of ten years ago took steps towards securing control of a sufficient quantity of land on both sides of the Falls for the free use of the public, where they would be protected from the annoyances and exorbitant charges to which they had hitherto been subjected. Under an act passed by the Ontario legislature in 1885 the Lieutenant-Governor was authorized to appoint a Board of Commissioners, whose duties were to select such lands as might be required for the above purpose. The Commissioners so appointed had surveys made, and recommended the purchase of the territory extending from the Clifton House southwards following the general direction of the river, and back therefrom a distance of about 300 yards to near the top of a wooded escarpment. The total area of these lands is 154 acres, including Cedar Islands, the Dufferin group of islands and the talus under the cliff from the Clifton House southwards to the margin of the Horse Shoe Fall. These lands were afterwards purchased by the government of Ontario by arbitration, at a cost of \$436,813.24, and now comprise the Queen Victoria Niagara Falls Park, the management of which is vested in the Board of Park Commissioners. Subsequently the Dominion government transferred all its rights in these lands to the Commissioner. Since the purchase by government of the lands comprising the Queen Victoria Park, a large amount of skilled attention, as well as expenditure of money has been devoted to the beautifying of the park grounds. It will be remembered that towards this object the

ment of operations by the company on the first of the present month, in fulfilment of the terms of their agreement. Visitors to the convention will have the opportunity of viewing these operations, and of learning the plan on which the company propose to utilize and



ROUTE OF THE NIAGARA FALLS PARK & RIVER RAILWAY.

transmit power from the Falls to manufactories in the immediate locality and eventually to distant points.

The company's agreement provides that they shall have completed by 1st November, 1898, water connections for the development of 25,000 h. p., and have actually ready for use 10,000 developed h. p. of electric or pneumatic power. After the visitors to the convention shall have seen the herculean task which has been accomplished on the American side of the river by the Cataract Construction Co., with which the Canadian company is closely identified, they will not be disposed to doubt the certainty of the successful completion of the Canadian undertaking.

Closely skirting the Canadian side of the river from Chippewa to Queenston runs the Niagara Falls Park and River Railway. A plan of the route, together with an illustration of the power house above the Falls, accompany this article. From the cars on this road the visitor is given a complete view of the river throughout those parts which are visited by the tourist. The road, which was completed in 1893, connects at Queenston with the Niagara Navigation Company's steamers from Toronto. The trip over this road from Queenston to the Falls is one of the most delightful to be found in the world. As will be seen by the programme, the freedom of the road, which is under the able management of Mr. Wilfred Phillips, has been generously tendered to members and friends of the Association while in attendance on the convention.



THE HOTEL LAFAYETTE, NIAGARA FALLS, ONT.

annual payment of \$25,000 by the Niagara Falls Power Co. has for a number of years past been devoted.

In this connection additional interest has been given to the coming convention by the recent refusal of the Ontario government to extend the time within which the power company might begin the construction of works for the utilization of the power of the cataract on the Canadian side of the river, and actual commence-

On the American side of the river the visitors are invited to witness many highly interesting and instructive sights, including a trip over the gorge railway, which, as stated in a previous issue, is built on the face of the cliff down near the edge of the seething current—as well as visits of inspection to various electric, hydraulic and chemical works clustered about the American

the annual Banquet, the success of which is assured, the above brief outline should suffice to show the attractive character of the arrangements which have been made for the entertainment and instruction of those who may attend this Convention.

Viewing the programme from a scientific and commercial point of view, it will be found to be not less



UPPER POWER HOUSE, NIAGARA FALLS PARK AND RIVER RAILWAY.



DUFFERIN ISLANDS FROM ABOVE WYNN'S.

Falls, and of which the gigantic works and equipment of the Cataract Construction Co. forms a fitting center.

The excursion to Buffalo and the inspection of the power house there, in which the current generated at Niagara Falls is received, transformed and put to commercial use, will certainly not be the least pleasant and instructive feature of the occasion.

Without entering into further details, such as are given in the programme, beyond a special reference to

satisfactory. The papers are of a highly interesting and instructive character, and should evoke valuable discussion.

Realizing that the Association should be made as helpful as possible to the electrical industries of the country, the Executive have recently issued a letter to electric lighting companies throughout the country, asking their attendance at this Convention in order that proper consideration may be given to ways and means

whereby the interests of private lighting companies may be saved from annihilation at the hands of the municipalities. As was pointed out in our last issue, this is a subject which should engage the immediate attention of all persons who have capital invested in electric lighting machinery. In the Canadian Electrical Association there exists ready to hand an organization which can be made use of to further this object. We therefore hope and expect to see the electric lighting interest largely represented at this Convention, and action taken which will prevent the wiping out of the large amount of private capital which has in good faith been invested in the electric lighting business.

AUTHORS OF C. E. A. CONVENTION PAPERS.

THAT our readers and members of the Canadian Electrical Association may become acquainted with the gentlemen who have consented to read papers at the forthcoming convention at Niagara Falls, we present the accompanying portraits and brief biographical sketches. One or two photos had not come to hand at time of going to press, consequently the omission.



MR. JOHN MURPHY,
Superintendent of Power Houses, Ottawa Electric Company.

Mr. Murphy was born in Ottawa and educated at the common schools. During a term at Ottawa University he acquired a taste for electrical work, and entered into employment with the Bell Telephone Company in 1884. He has been continuously engaged in various branches of electric light and power work since that time, and during the past three years has occupied the position of superintendent of power houses for the Ottawa Electric Company.

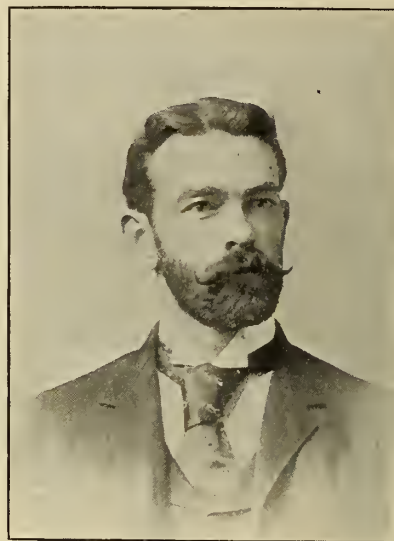


MR. F. C. ARMSTRONG,
Chief Sales Agent Canadian General Electric Company.

For a number of years Mr. Armstrong has been connected with the Canadian General Electric Company, of late years as chief sales agent. He is well-known in electrical circles, and has taken an active interest in the work of the Canadian Electrical Association, having served as a member of the Executive Committee, as well as contributed papers on different subjects at past conventions.

MR. J. A. KAMMERER,
Chief Sales Agent Royal Electric Company.

Born at Suspension Bridge, N. Y., Mr. Kammerer was educated at the public and private schools at that place. Up to the year 1880 he was engaged in different branches of railway work, and for the following eleven years in train dispatching in the United States and Canada. Since April, 1891, he has been connected with the Royal Electric Company, of Montreal, and now occupies the position of chief sales agent, with head office at Toronto. We regret that we are unable to publish portrait herewith.



MR. W. A. JOHNSON.

Mr. Johnson has been connected with electrical matters and manufacturing for 22 years, for the last 15 years having made a specialty of dynamos, arc lamps, accumulators, etc. Previous to 1894 he was general manager of the Ball Electric Light Co. (the pioneer manufacturing company of Canada), he having successively acted for said company as mechanical superintendent, secretary and engineer. Early in 1894, after disposing of his interest in the Ball Company, Mr. Johnson started a manufacturing and contracting business under the style of W. A. Johnson Electric Company, and has built up a large and increasing trade. His long practical experience has secured to his firm the Canadian representation of several well-known American firms, such as the Electric Storage Battery Co., the Walker Railway apparatus, the Wagner transformer, the Manhattan and Puritan arc lamp, etc.



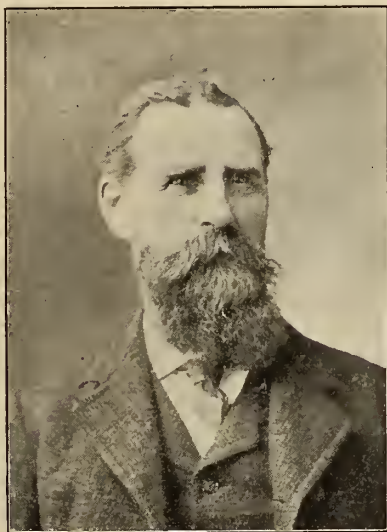
MR. WILLIAM THOMPSON,
Superintendent Waterworks and Electric Light Plant, Montreal West, Que.

Mr. Thompson was born in Middlesbro', Eng., the home of the iron trade, and came to Canada in 1883, finding employment in Toronto and Brampton.

Since 1891 he has been employed by Armstrong & Cook, as superintendent and chief engineer, operating

their waterworks and electric light plant at Montreal West, Que. Both the electric and waterworks systems were installed under his supervision.

To thoroughly equip himself and master all the details of his profession, Mr. Thompson has taken a special course in analytical chemistry under the tuition of the well-known chemist, Prof. J. T. Donald, of Bishop's University, Montreal.



MR. A. M. WICKENS,
Electrician and Engineer for the Ontario Government.

Mr. Wickens served his apprenticeship as a machinist at the works of the Waterous Engine Works Company, Brantford, leaving there at the expiration of his term for the western states. Returning to Canada in 1874, he was employed as erecting engineer for the Worswick Engine Co., of Guelph, until 1885, at which time he moved to Toronto, taking the situation of engineer at the Globe office. This was when the first incandescent lights were installed in Toronto. When the Globe office was moved to the new building at the corner of Yonge and Melinda streets, a change was made from a shafting and belt transmission to an electric drive and transmission of power, this equipment being the first of its kind in Canada, and consisting of a motor for each machine, making a total of 14 motors for 58 or 60 h.p. These were the first motors in use in the city of Toronto. Shortly after this plant was installed Mr. Wickens accepted his present position as engineer and electrician for the Ontario government.



MR. C. E. A. CARR,
Manager London Street Railway Company.

Mr. Carr was born at Barrie, Ont., and at the age of sixteen years removed to Toronto, where he took a three years' course in a commercial college. He was afterwards employed for three years in the office of Mr. W. T. Jennings, then city engineer of Toronto, during

which time the street railway was transferred from the Frank Smith Company to the city, and afterwards to the present company. In this connection Mr. Carr became familiarly associated with street railway matters. Early in the year 1893 he accepted the position of private secretary to Mr. H. A. Everett, manager of the Toronto Railway Company, and shortly afterwards the greater portion of the system was converted into an electric road, which afforded Mr. Carr much practical experience in the equipment and operation of an electric railway. His appointment as manager and treasurer of the London Street Railway Company was made on February 11, 1895, since which time the road has been changed to an electric system.

MR. D. H. KEELEY,
Superintendent Government Telegraph Service.

Mr. Keeley has long been prominently connected with telegraph work, having for a number of years been employed as assistant to the late Mr. F. N. Gisborne, who was superintendent of government telegraphs from the beginning of the service until his death in the year 1892. Since that time Mr. Keeley has had entire charge of this service, executing his duties in a manner which is said to be highly satisfactory to the department. His wide and varied experience, as may be estimated from the fact that the government telegraph service now includes 2,451 miles of land lines and 206 miles of submarine cables, assures an interesting paper at the approaching convention.

A BIT OF TELEPHONE HISTORY.

At the annual dinner of the National Telephone Company of Great Britain, held in London the other day, Mr. W. H. Preece, in responding to a toast on "Telephony," gave an interesting bit of history anent the early days of the telephone. "Exactly 20 years ago," said he, "the postmaster general of that day commissioned Mr. Fischer and myself to proceed to America for the purpose of inquiring into the invention of a curious instrument that transmitted the voice from one end of the land to the other." He went determined to expose the fraud, but had not been in company of Graham Bell five minutes before he became an ardent believer, and ever since then the apostle of the telephone. Comparing the receiver of to-day with what he brought from the States 20 years ago, there was not very much difference. In extending the use of the telephone in England they had to encourage mutual assistance between the suppliers and the subscribers. The system was growing very rapidly in England, and although the trunk wires had fallen into the hands of the post-office, there were more trunk wires being operated in Great Britain than in the whole of Europe.

A good artificial water cement is obtained by heating for some hours to redness a mixture of 3 parts of clay and 1 part of slaked lime by measure.

The Consolidated Railway Company's system in Victoria, Vancouver and New Westminster, has passed into the hands of an English syndicate, to be known as the British Columbia Electric Railways Company, Limited.

Mr. A. J. Corriveau, who was one of the promoters of the Montreal Park and Island Railway, is now forward with a scheme to construct a network of trolleys through the eastern townships of Quebec, connecting Montreal and the south shore with St. Johns and other leading towns. The line as proposed would be one hundred and fifty miles in length, and would pass through Chambly, St. Johns, Bedford, Cowansville, St. Hyacinthe, Sweetsburg, Knowlton, Magog and Sherbrooke. The power is to be obtained from the Chambly Water Power Company, and the cars are to be run forty miles an hour. The capital required, which is to be provided by Canadians, Americans and Parisians, is placed at \$2,000,000.

An engineer gives an account of a method of removing and replacing a broken foundation bolt for an engine as follows: A 3-inch bolt was broken off below the capstone, about 40 inches from the top nut. The upper piece was removed and a one inch ratchet bit inserted through its 4-inch pipe case and a short vertical hole drilled in the top of the broken piece and threaded to receive a left-hand eye bolt, by which the bolt was unscrewed from lower nut (that was fortunately set in a pocket of the bearing casting) and lifted out of the hole, a piece welded on threaded, provided with a right-handed stud eye in the top to handle it and screw it into the bottom nut again, and it was successfully replaced and the connection with the bed plate restored.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

NOTE.—Secretaries of Associations are requested to forward matter for publication in this Department not later than the 25th of each month.

BROCKVILLE NO. 15.

J. Aikens, secretary of the above association, writes : "At our last regular meeting we had the pleasure of initiating two new members, and several others are making enquiries about joining. Bro. John Grundy suggested the plan of having junior and senior classes in our educational department, as some members could not work out the more advanced rules. The idea proved to be a good one, and much appreciated by the members. Brother Grundy is junior teacher and past president; Bro. Chapman senior teacher.

ANNUAL BANQUET OF HAMILTON NO. 2.

A large number of engineers and their friends gathered at the Commercial Hotel, Hamilton, on the evening of the 15th ultimo, the occasion being the annual banquet of Hamilton No. 2, C.A. S.E. Mr. R. Mackie performed the duties of chairman in his usually happy manner. Among those present were Ald. Findlay, Donald and McLeod; Messrs. Geo. Black, manager G. N. W. Telegraph Co.; W. H. Ballard, Inspector of Public Schools, and Mr. Gill, B.A., of the Collegiate Institute. A first-class supper was served by Mr. Maxey, and was followed by the toast list, "The

grew; "Manufacturers," Mr. Rodgers; "Sister Associations," Messrs. Walter Hosie, Toronto, and J. Geary, Guelph; "The Learned Professions," Messrs. George Black, W. H. Ballard and Mr. Gill; "The Press," Mr. J. H. Mattiee, of the Globe, and the Host and Hostess, Mr. Maxey. The musical programme consisted of solos by Messrs. W. S. Hyslop, M. Wilson, W. Hood, Rod Hariss and W. S. Wilson, and duets by Messrs. Hyslop and Wilson, Mr. T. Blain playing the accompaniments. The committee in charge of the

banquet was composed of Messrs. R. Mackie, chairman, J. Ironsides, secretary, W. Norris, W. Stevens, J. Johnston and W. Cornish.

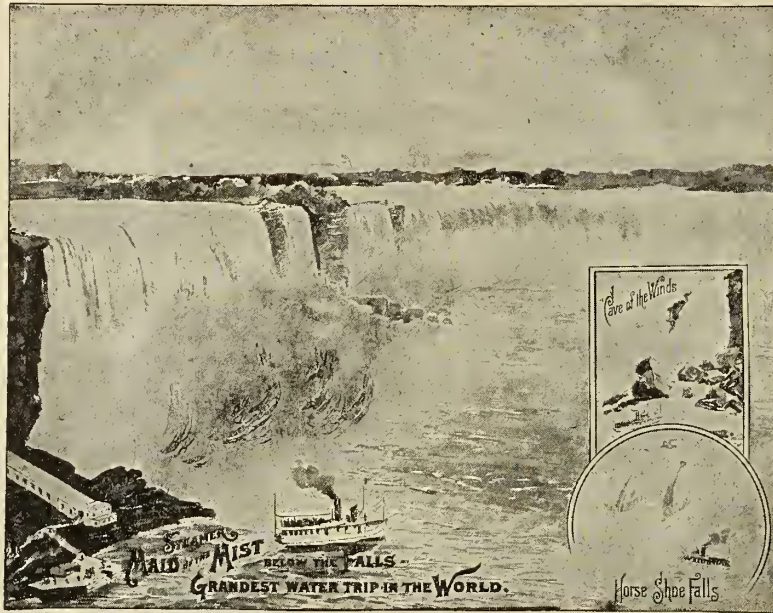
THE ENGINEERS' ACT.

The committee appointed by the Canadian and Ontario Associations of Stationary Engineers to look after the proposed license bill to be presented to the Dominion government expect to go to Ottawa early this month. The bill will likely be considered by the committee within the next two weeks, and Messrs. A. M. Wickens, Arthur Ames and

James Devlin will be present to explain its objects. It is the desire of the stationary engineers to be placed on the same footing as the marine engineers, and it is hoped that this will finally be accomplished.

The Bedford Electric Company will shortly erect a power house at Halifax, N. S.

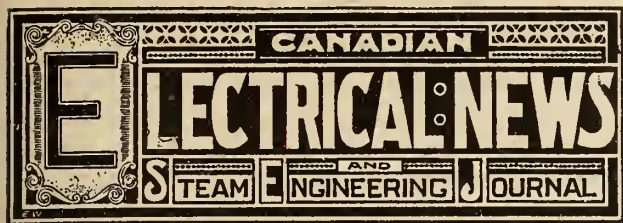
Mr. J. G. Lawson, for several years past foreman engineer on



"MOWAT GATE," AT ENTRANCE TO QUEEN VICTORIA PARK, NIAGARA FALLS, ONT., SHOWING N. F. P. & R. R. IN THE DISTANCE.

Queen" and "Governor-General" being duly honored by singing "God Save the Queen" and "The Maple Leaf Forever." The various toasts were responded to as follows: "Dominion Parliament and Local Legislature," Mr. James McGlanchlin; "Our Army and Navy," Mr. T. Carter; "The Mayor and Corporation," Ald. Findlay, Donald and McLeod; "Executive Head," Messrs. A. M. Wickens, W. Blackgrove and R. Petti-

the construction staff of the Canadian General Electric Company, has severed his connection with that company and gone to England to join Mr. W. Rutherford, formerly chief engineer of the Canadian General Electric Company and now manager of the electric traction department of the English firm of Dick, Kerr & Co. Mr. Lawson's departure is much regretted, not only by the members of the C. G. Company's staff, but also by the electrical public generally in Canada who have had an opportunity, through personal contact, of appreciating his thorough knowledge of practical electric-technics and his estimable personal character.



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Advertising rates sent promptly on application. Orders for advertising should reach the office of publication not later than the 25th day of the month immediately preceding date of issue. Changes in advertisements will be made whenever desired, without cost to the advertiser, but to insure proper compliance with the instructions of the advertiser, requests for change should reach the office as early as the 22nd day of the month.

SUBSCRIPTIONS.

The **ELECTRICAL NEWS** will be mailed to subscribers in the Dominion, or the United States, post free, for \$1.00 per annum, 50 cents for six months. The price of subscription should be remitted by currency, registered letter, or postal order payable to C. H. Mortimer. Please do not send cheques on local banks unless 25 cents is added for cost of discount. Money sent in unregistered letters will be at sender's risk. Subscriptions from foreign countries embraced in the General Postal Union \$1.50 per annum. Subscriptions are payable in advance. The paper will be discontinued at expiration of term paid for if so stipulated by the subscriber, but where no such understanding exists, will be continued until instructions to discontinue are received and all arrears paid.

Subscribers may have the mailing address changed as often as desired. When ordering change, always give the old as well as the new address. The Publisher should be notified of the failure of subscribers to receive their paper promptly and regularly.

EDITOR'S ANNOUNCEMENTS.

Correspondence is invited upon all topics legitimately coming within the scope of this journal.

The "Canadian Electrical News" has been appointed the official paper of the Canadian Electrical Association.

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Information regarding examinations will be furnished on application to any member of the Board.

THE attention of our readers is directed
A New Department. to the "Educational Department"
which appears for the first time in this
number. This department has been established in the
interest and for the benefit of students of electricity and
steam engineering who may be desirous of qualifying
themselves to fill positions of responsibility in the future.
The first of a series of articles by Mr. Wm. Thompson,
of Montreal, written with this object in view, appears in
the new department in the present number. Much of
the information which will appear from month to month
in these articles will be adapted to the requirements of
engineers who may wish to qualify themselves to pass
the examinations of the Ontario Association of Stationary
Engineers. These articles will well repay perusal
by persons desirous of gaining a clear and thorough
knowledge of the foundation principles of mathematics,
and of electricity and steam engineering, for the proper
understanding of which a knowledge of mathematics is
essential. In anticipation of large additions to the
number of our subscribers, several hundred copies of
the issues of **THE NEWS** containing the first of this
series of articles, will be preserved. Our readers will
confer a favor by making as widely known as possible
the fact of the publication of these articles.

Value of Mechanical Stokers.

THE American Steam Users' Association recently sent out enquiries designed
to draw forth information as to the
value of mechanical stokers. The questions asked
were: "Do Stokers Save Coal over Hand Firing?"
"Do Stokers Save Labor over Hand Firing?" "Do
Stokers Save Smoke over Hand Firing?" In answer
to the first question, one report showed a loss, five no
saving, and six a saving. To the second question one

answer showed an increased cost for labor, three no saving, and eight a saving. To the third question replies from two soft coal plants were in the negative, and seven in the affirmative. None of those who sent in replies would undertake to state that a net gain had been effected by the use of the stoker. We would be pleased to print the views of any of our readers who may have had experience with apparatus of this character, or with any kind of apparatus by the use of which it is claimed to be possible to effect a saving in fuel while maintaining the efficiency of the steam plant. The coal pile is the direction in which every owner and operator of a steam plant should turn his attention in these days of enforced economies. In times past, when the principles of combustion and of steam generating appliances were less perfectly understood than to-day, many a fortune went up the chimney in the form of smoke. And notwithstanding the advancement that has taken place in engineering knowledge, the waste of fuel is still enormous.

TRANSFORMERS are frequently regarded as a very simple piece of apparatus, that need not be taken any further notice of once they are securely put up on their pole and connected into the lines. And yet the more they are studied the more features they present worthy of careful attention. We have referred before to the advantage of selecting transformers less on the basis of price than on that of efficiency, and we would draw attention to some of the effects of the "drop" as seriously affecting the service. It is becoming more and more usual to use transformers "banked" on secondary mains, so that more equal distribution of potential may be attained, and to economize in the matter of transformers. Now if different makes, or even different sizes of the same make be employed, it is extremely probable that they will have different "drops," so that if they be all connected to the same secondaries, it is evident that those that have the smallest drops will take more than their due share of the load. This condition may exist to such an extent that a very few low-drop transformers may have to take the whole load of a circuit, in which case the least unfavorable result will be the diminution of the voltage on the lamps, and may possibly even cause fuses to go on the transformers; or if overfused they may burn out. That this is not a visionary result, the possibility of which exists only in the mind of a pure theorist, is evidenced by the recent trouble on a system in western Ontario, which was traced to this cause.

Process of Restoring Belting. THE Electro Zeitschrift describes a new process of restoring worn out belting which has recently been brought

out by Max Krieger & Co., Berlin, and which consists essentially in imbedding the belting, after it has been thoroughly cleaned, in a special composition and subjecting it therein to a moderate heat. This composition, which contains a number of different silicates, serves two purposes, namely, to add fat to belts which have lost their pliability, and abstract it from those which already have too much. The fat seems to flow from the belt to the composition, or vice versa, till a kind of equilibrium is established. The effect of the silicate composition can be increased by raising the temperature, so that by this means old resined belts can be re-

stored to their original pliability, and made available for use for a considerable time longer. A second advantage of this moistening of the leather consists in this, that stretched belts under this treatment return to their original length. If a belt, therefore, is first saturated with fat and then deprived of it by this process, it becomes more dense and lasts longer. It acquires an extraordinary power of resisting subsequent stretching. Belts that have been treated in this way work very uniformly for a long time, and require very little lubricating. The use of resin, etc., for increasing friction becomes altogether unnecessary. The power of absorbing lubricants is very much reduced, so that the belts will run a long time before they require to be treated again. The inventors assert that the life of a belt is doubled by this process, an assertion which, if verified, ought to lead to its being extensively adopted.

Central Station Management.

ELECTRIC lighting companies and consumers alike, are interested in the matter of rates, and this is a matter to which a great deal of attention is being paid by the more enterprising class of managers. In order to popularize electric light, it is necessary to give good light, and to supply it at a very reasonable cost. More especially is this so in places where consumers are under the necessity of exercising economy, and where, in consequence, the relative value of coal oil is higher than in towns where business is larger and more remunerative. As a general rule, not sufficient attention is paid to offering inducements to the more remunerative class of consumer, while such poor business as that afforded by churches, lodges, rinks, &c., is eagerly sought for. A church, contracting for 100 lights, must have that capacity always kept for it by the central station, which therefore cannot obtain for that 100 light capacity as high figures as it does for 100 light capacity rented for commercial or residential purposes, because churches and halls usually obtain considerably reduced rates. It is not safe to assume that the churches will be lighted only on nights when stores, &c., are not, because there are evening services on week days and festivals, when their load is on at the same time as the ordinary commercial load. It is therefore only just that such places should pay for their lighting a proportionately higher rate. The lighting period should be divided into parts, representing period of heavy load, of half load and of light load; and inducements should be offered to consumers to arrange for such consumption as they require to be at light load periods as much as possible. A little reflection will indicate to thoughtful, enterprising managers many ways of increasing their income without proportionately increasing their expenses.

State Regulation of Companies.

THE extent to which socialistic ideas prevail in these modern times is forcibly illustrated by the recent enactment of the Indiana State Legislature reducing street car fares in Indianapolis from five to three cents. It seems a monstrous thing that companies who have interested large amounts of capital in an enterprise designed to serve the public convenience, should be obliged to charge for their service whatever price the legislature may determine. No objection is raised to the right of the municipal and state governing bodies to regulate within reasonable limits the charges of com-

panies operating under public franchises, but it is manifestly unjust that these bodies should have the power to absolutely fix a maximum price for the service rendered by such companies. In nine cases out of ten governing bodies lack the requisite information regarding cost of plant and operation of such companies to enable them to determine what the charge for service should be in order that the company may realize something upon its invested capital and the labor devoted to the conduct of the enterprise. The public are too prone to regard companies as proper objects for assault in any and every form. The suspicion that a company is making a few dollars as the result of its enterprise, is sufficient to arouse public jealousy and opposition. If this condition of affairs continues to develop it will be the means of checking enterprise and improvement to a very deplorable degree. The decision of the Courts as to the legality of the Indiana Statute above referred to will be awaited with interest. It is extremely doubtful whether under the most favorable circumstances a street railway company can pay its way on a three cent fare,

versation by telephone in all parts of America, the Japanese use words corresponding in meaning to "You! You!" The opening of the first telephone line in Japan was made the occasion of a public holiday, and it is recorded that thousands of the natives took up a position along the line for the purpose of seeing the first message travel along the wire.

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I LEARN that you propose to publish, before the thermometer takes another rise, and the recollection of the recently vanished coal pile passes out of mind, some particulars and illustrations of electric heating appliances, and the uses to which they are adapted. In next issue I may feel called upon to dilate upon the heat dispelling qualities of the electric fan. It is thus that in the endeavor to be up-to-date we must suddenly switch out of one set of conditions into another.

ELECTRIC HEATING AND COOKING APPLIANCES.

THE Canadian General Electric Company are now



ELECTRIC HEATING AND COOKING APPLIANCES.

especially in view of the fact that the traffic is constantly being reduced by the use of the bicycle. If we mistake not, one or two American street railway companies voluntarily gave the three cent fare a trial a year or two ago, but were compelled to abandon the experiment, on the ground that it could not be made to pay.

BY THE WAY.

A LEARNED commission of German experts has arrived at the following definition of a boiler explosion:—"A steam boiler explosion takes place when the walls of a boiler undergo, through the working of the boiler, a rupture in such a way that, through an outburst of water and steam, a sudden equalization of the pressures interior and exterior to the boiler occurs." That is to say, a steam boiler explosion is what takes place when the boiler bursts!

× × × ×

WE are told that instead of the word "Hello," which has come to be the recognized introductory to a con-

offering for sale a complete line of electric heating and cooking appliances, manufactured by the American Electric Heating Corporation of Boston. These appliances have been worked out very carefully in detail, so as to secure the greatest possible durability and economy in operation, and seem likely to find a very wide market throughout the Dominion, especially at points where a day service is furnished by the local lighting company. The convenience, cleanliness and general desirability of electrical appliances for heating and cooking will be recognized, while at the prices at which current is sold now-a-days, their economy is sufficiently high to admit of their having in the immediate future a wide field for usefulness. We present a cut showing an assortment of these appliances, which include a wide range of articles for different purposes, including room heaters, car heaters, baking ovens, chafing dishes, five o'clock tea sets, portable stoves, broilers, sad irons, curling tong heaters, tailors' irons, hot water urns, glue pots, and a great number of equally useful articles.

THE WATER POWER OF THE CHAUDIERE FALLS.

THE attention now centred in water powers as a means of developing electricity, and the increasing adaptability of the latter for commercial purposes, justifies the following description and illustrations of the Chaudiere Falls. These falls are situated on the Chaudiere river, about two miles from its junction with the St. Lawrence river,



CHAUDIERE FALLS—LOOKING SOUTH.

six miles below the city of Quebec, and are said to offer excellent facilities as a manufacturing centre. It is the only water power of any size now available on the south shore of the St. Lawrence in that vicinity, and will probably be utilized at an early date for supplying electric light and power to the adjacent municipalities.

At the request of Messrs. Hall & Price, of Quebec, a report on the power of the river at the falls was made by Mr. W. A. Ashe, C.E., of Quebec. The report states that from the cross-section of the river, at the point A-B on the accompanying "plan of a part of the Chaudiere river," the river was discharging 1,365 cubic feet per second, or 5,118,750 foot pounds per minute, or the equivalent of 155.1 h.p.

Mr. Ashe further says: "Ninety-four (94) feet of head could be obtained between the point marked 'high water level' and the crest of the falls, and it is this head that I should recommend the use of, when the fullest power is required of the falls. With this head and the flow we have determined, we should obtain 14,610 gross horse power, and, assuming the effective horse power as being 65 per cent. of this (really 10 per cent. less than we should get from a properly constructed turbine), this head would give us 9,497 effective horse power; and, as we have decided to only count on half these amounts, the greatest horse power that these falls can be certainly depended on to furnish at the lowest stage of the river would be 4,750 h. p.

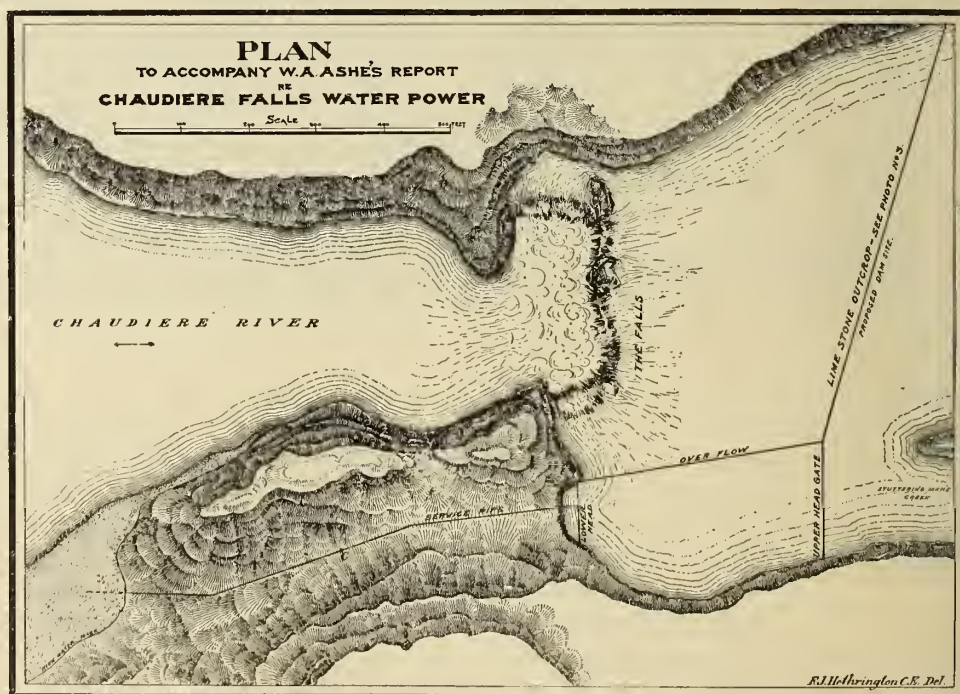
The head which I should recommend on account of convenience in situation, being some 350 feet nearer the falls than in the last case, would be at the point "C" (see plan of Chaudiere Falls). Here we should obtain a head of 79 feet, and the powers which we should ob-

tain would be as follows: 12,253 gross, or 7,964 effective horse power. So that, assuming half this amount as being absolutely safe to count upon for the lowest possible stage of the river, we should obtain 3,980 effective horse power."

There is a natural trench through which the conducting pipe could be laid from the level of the top of the falls to the point "C," and at the lower point where the "lower head" with the intake to the conducting pipe would be made, the river bed between the island and main land is only about 100 feet wide, and could be easily dammed, having an outcrop of limestone which would form an excellent foundation, while the overflow would discharge immediately into the falls without further expense.

Concluding his report, Mr. Ashe states that the Chaudiere Falls as a power is superior in every sense to that of the Falls of Montmorency. Great as is the total available head of the Montmorency River, this is more than compensated by the greater volume of water passing through the Chaudiere, not at any particular time, but at the lowest stages of either river.

The latest turbines being guaranteed to reproduce 80 per cent. of the gross horse power, and taking the gross horse power as calculated by Mr. Ashe as 12,253 at 79 feet head, we find the actual effective horse power to be 9,802; and taking one-half of this as he does for the lowest possible stage of the river, we get 4,901 effective h.p.



This valuable water power is now owned by Mr. H. M. Price, of Quebec.

IMPROVING EVERY YEAR.

MR. Harry Kendrick, Walkerville, Ont., writes: "Find enclosed \$1.00 for my subscription to May, 1897. I think your journal is improving every year. I think every number is worth keeping for future reference. I have all the numbers for at least four years back."

Close the valve on the discharge pipe of your steam pump while it is running, and unless it stops, the valves, plunger, or both leak

TORONTO TECHNICAL SCHOOL EXAMINATIONS.

We print below a copy of the examination papers in Electrical Engineering and Steam and Steam Engine, submitted to students of the Toronto Technical School at the close of the session, these subjects being under the direction of Mr. Jas. Milne. In our July issue we hope to publish correct solutions of the questions, and students and others interested are asked to work out the problems and compare their results with the answers to be given.

ELECTRICAL ENGINEERING.

200 marks will constitute a full paper. The value attached to each question is shown in brackets.

1. What data do you require for determining the amount of current as measured by the Tangent or Sine galvanometer? Work out the formula, and make the necessary sketches to illustrate your answer. [25]
2. How would you determine the value of an unknown resistance if you were supplied with a Weston voltmeter, the resistance



of which is known, together with a known E.M.F. and whatever wires, etc., are necessary for making the necessary connections? If voltmeter has 20,000 ohms R, and the E.M.F. is 500 volts, when the unknown R is put in circuit voltmeter shows 375 volts, what is the value of the resistance? [25]

3. With a shunted galvanometer, when a resistance of .1 megohm was in circuit, a deflection of 10° was observed when battery key was pressed. With same battery and shunt removed, there was a deflection of 5° when a certain resistance was in the circuit. Determine the value of the resistance. The resistance of the galvanometer was 7,920 ohms, and the shunt was $1/99$ th. Omit in the calculation the battery resistance. Make a sketch of the arrangement, and show clearly how you arrive at your results. [30]

4. The electro-chemical equivalent of zinc is .00034. What do you understand by this? What would be the deposit in an Edison chemical meter, the German silver shunt having a resistance of .01 ohms, and the resistance of the voltmeter and the coil in series with it is 48.96 ohms, when a current of 100 amperes has been passing for 4 hours. Make a diagram showing the arrangement. [35]

5. In an Edison underground 3-wire system, the distance from power-house to feeder junction box is 6,000 feet. The copper resistance is .017 ohms per 1,000 feet. The two outside wires are looped together at one end (the junction box), and at the other the ends of the loop are attached to the terminals of a galvanometer. A 150-ohm resistance coil of 200 turns is also connected to the terminals of the galvanometer, and at a distance of 20

turns from one end one pole of a 4-cell battery is attached, the other pole being attached to ground. In this position there is no deflection of the needle. Find the location of the fault, and give distance in feet from the power-house. [35]

6. What is the size of the conductor in the above question? [25]

7. What data would you require to determine the permeability of an electro-magnet core which lifts a weight of P pounds? Investigate a formula. What do you understand by permeability? [40]

8. A current of 20 amperes, flowing through a resistance of 10 ohms, heats 20 lbs. of water from 60° to 70° Fah. How long was current flowing, supposing there was no loss by radiation? [30]

9. What is the efficiency of an electric motor when running up to its maximum? Prove it. [30]

10. Describe the Aron or Thomson wattmeter. [30]

11. Make a diagram showing the connections in the Brush or Thomson-Houston arc dynamos. Make sufficient sketches to fully illustrate the changes that take place in one revolution. Also describe some form of regulator for arc machines. [30]

12. What does the torque of a motor depend on? Prove your statement. [30]

13. What do you understand by the "Constant" of a galvanometer? What data do you require in determining it? Give an example, and show clearly what is meant by it. [30]

STEAM AND STEAM ENGINE.

ELEMENTARY.

115 marks will constitute a full paper.

1. Distinguish between heat and temperature. What are the units by which each are measured? How many units of heat are required for raising 1 lb. of water from 32° F. to 212° F. and then evaporating it into steam? How much mechanical work would be done in each operation? [15]

2. Steam expands in the cylinder of an engine from a pressure of 35 lbs. above to 5 lbs. below atmosphere; at what part of the stroke was steam cut off? Find the mean pressure, taking 15 lbs. per square inch as atmospheric pressure. [15]

3. Sketch in section the parts of a steam cylinder, and show by means of three separate sketches any form of slide valve you prefer to illustrate, wherein (1) the valve has no lap; (2) the valve has lap on steam side; (3) the valve has lap on both steam and exhaust sides. In each drawing the valve must be shown in its mid position. [15]

4. What diameter of a cylinder will be required to develop 60 h. p. in a non-condensing engine. Stroke 3 feet, 60 revolutions per minute. Initial gauge pressure, 60 lbs. Cutting off at $1/5$ stroke. [15]

5. A safety valve, 3" diameter, is held down by a uniform lever and weight. The lever is 30" long and weighs 10 lbs., and the valve weighs 4 lbs.; distance from fulcrum to centre of valve, 4". If the weight at the end of the lever is 60 lbs., at what pressure will the valve be lifted? Make a sketch showing the valve, seating, and the general arrangement. [15]

6. What do you understand by jet and surface condensation respectively? Give a sketch of each arrangement. In a surface condenser there are 1,000 brass tubes, each 6 feet long and 1 inch outside diameter; what amount of cooling surface would such a condenser provide? Allowing 3 square feet per horse power, what would be the rating of it? [15]

7. Sketch a link motion reversing gear for a locomotive or marine engine, and explain how the reversal is effected. [20]

8. Taking steam at 50 lbs. above that of the atmosphere, sketch three diagrams showing the amounts of work obtained from a given weight of steam: (1) when used in an engine without expansion or condensation; (2) when the steam is cut off at $1/5$ stroke, but not condensed; (3) when cut off at $1/5$ stroke and condensed. [20]

9. Make a sketch showing the setting of a return tubular boiler. Which of the seams are double rivetted and which of the seams are single rivetted, and why? [20]

10. What is the height of the cone of an ordinary pendulum governor which makes 80 revolutions per minute? Make a diagram of the arrangement, and show how the movement at the governor is communicated to the throttle valve. [20]

11. If 200 tons be lifted 6' in 10 minutes by a steam engine, wherein the diameter of the piston is 20", the mean pressure on the piston is 20 lbs. per square inch, length of stroke 4', and the number of double strokes 15 per minute. What proportion of the power applied is lost in the working of the machinery? [15]

ADVANCED.

200 marks will constitute a full paper

12. The steam ports in a cylinder are $2\frac{1}{2}$ " wide, the lead of the valve is $\frac{1}{8}$ ", outside lap $1\frac{3}{4}$ ", inside lap $\frac{3}{16}$ ". Valve travel, $5\frac{3}{4}$ ". Determine the maximum openings for steam and exhaust. [25]

13. The stroke of an engine is 24"; connecting rod, 4' long; valve travel, 4"; outside lap, 1"; inside lap, $\frac{1}{4}$ "; lead $\frac{3}{16}$ ". Find the positions of the piston at the points of cut-off, release, compression, and admission respectively. Draw the hypothetical indicator diagram which such an engine would afford. [30]

14. The diameter of a steam cylinder is 8"; piston stroke, 18"; number of revolutions, 150 per minute; initial pressure, 85 lbs. gauge; cut-off, $\frac{1}{5}$ th stroke; 3 lbs. back pressure above atmosphere. Find 1 h.p. hyp. log $5 = 1.61$. The same engine is tested by a brake pulley on crank shaft 5" diameter, the effective load being 260 lbs., radius 2.5 feet. Find the Brake h.p. and the working efficiency of the engine. [25]

15. In a marine engine fitted with surface condenser the steam reaches the condenser at a mean absolute pressure of 3 lbs. per

square inch, and is condensed to water at 120° Fah. How many pounds of circulating water, which enters at 60° Fah. and is discharged at 100° Fah., would be required for every pound of steam condensed? The temperature of steam at 3 lbs. pressure being 142° Fah. [30]

16. Explain the effects of inside and outside "lap," "lead," "cushioning," "wire-drawing," and "release" on the indicator diagrams, making such sketches as may be necessary to render your answer clear. Mark on your diagrams the points of admission and cut-off. [25]

17. Explain clearly in what manner and to what extent clearance will affect the indicator diagram of an engine. What would be the difference in the diagram of an engine working with steam at 100 lbs. absolute, cutting off at .25 stroke, when the volume of the total clearance in cylinder and in passages is equal to $\frac{1}{10}$ th and $\frac{1}{8}$ th respectively of the contents of the cylinder? [30]

18. How would you combine into one diagram the indicator cards from the two cylinders of a compound engine? State fully what data you would require in addition to the actual cards. [30]

19. Given Unwin's proportion $d = 1.2 \sqrt{P}$, determine the pitch, size of rivets, together with the relative strengths of single, double and triple riveted joints for $\frac{3}{4}$ " plate, assuming that the shearing strength of the rivet is equal to the tensile strength of the plate. [35]

20. In a boiler 25' long and 7' diameter, having two flues 30" diameter, find the bursting pressures in the longitudinal and transverse seams, if the ultimate strength of the double and single riveted joints are 35,000 and 28,000 lbs. per square inch respectively, thickness of plate $\frac{1}{2}$ ". [30]

21. In the city of Toronto a boiler test was being conducted, and it was found that the average evaporation for 10 hours was 4,000 lbs. water per hour, and the average hourly consumption of coal was 400 lbs. The water was supplied from the city mains at 40° Fah., after which it was pumped through an exhaust steam heater, which raised the temperature to 200° Fah. At this temperature the water entered the boiler. The average gauge pressure was 150 lbs. If the calorific value of the coal is 12,800 B. T. U. per pound, calculate the efficiency of the boiler, and taking what is known as the Centennial Standard as a basis of computation, find the horse power of the boiler. What is the equivalent evaporation from and at 212° per pound of coal, and what is gained by having the feed water heater? The temperature of steam at 150 lbs. pressure is 366° Fah. [50]

22. In a triple expansion engine the ratio of the cylinders are as 1 : 2.5 : 6, and the M. E. P. brought to a low pressure cylinder basis is 30 lbs. Find the M. E. P. on each piston, so that all three cylinders will be doing exactly the same amount of work, the stroke being the same in each case. If the area of the L. P. cylinder is 4071.5 sq. in., what is the diameter of the high and intermediate cylinder? [25]

23. Sketch and describe the action of the indicator for measuring the power of an engine. The scale of an indicator diagram is 60 lbs. to the inch, the area of the diagram 4 square inches, and the greatest length parallel to the atmospheric line is 2.5", the crank 13", the diameter of the cylinder 15", and the number of revolutions per minute 80. Find the I. H. P. [25]

TRADE NOTES.

Mr. Edward Slade has recently commenced business at No. 137 St. John street, Quebec, as an electrical engineer and contractor.

Messrs. Geo. White & Son, the enterprising proprietors of the Forest Machine Works, London, have moved into their new machine shops, which have been thoroughly refitted. They report good business in their line, and excellent prospects.

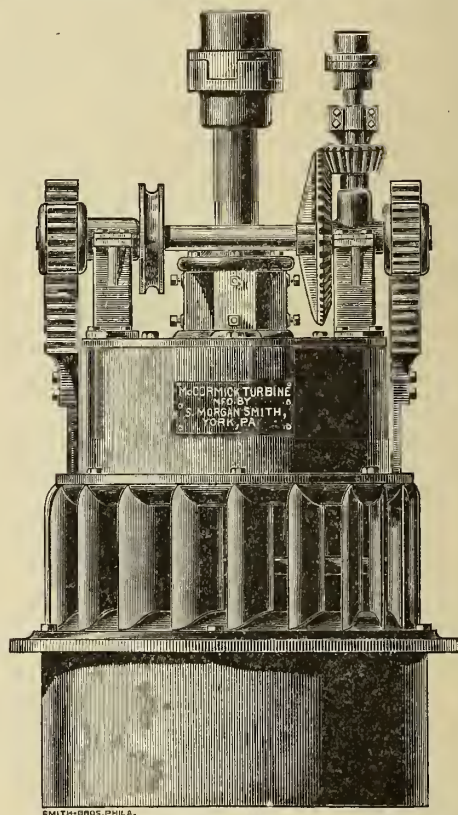
Messrs. Collyer & Brock, electrical engineers and contractors, of Montreal, have been retained by the Stadacona Water, Light and Power Company, as consulting and supervising engineers in the installation of an electric light and power plant in the town of Huntingdon, Que. A fine water power is being developed on the Chateauguay river, and the plant will be operated on the 220-volt direct current system. They expect to have the plant in operation by the first of June.

W. A. Johnson Electric Company, 34 York st., Toronto, report the following sales made during the last 60 days, and not previously reported:—Thos. B. Angrove, Kingston, Ont., 3 h.p. motor; Theo. Fredrick, Ottawa, Ont., 1 h.p. motor; Antelope Bicycle Works, Toronto, 12 h.p. motor; Nasmith & Co., Toronto, 4 h.p. motor; D. Hibner & Co., Berlin, 150-light incandescent plant; W. J. Miller, saw mill, Thessalon, Ont., 30-light incandescent plant; Grip Engraving Co., Toronto, 8 h.p. motor; Murray Printing Co., Toronto, four 3 h.p. motors; Luxfer Prism Co., Toronto, one 600-ampere dynamo for depositing copper, and one 4 h.p. and one 6 h.p. motor; McLaren & Co., St. Catharines, one 3 h.p. motor; Rat Portage, Ont., two 3 h.p. and one 5 h.p. motor; New Denver Electric Co., 500-light incandescent plant complete; Rat Portage Electric Co., 100 are light automatic dynamo and lamps, one 4-panel marble plug switchboard 12 x 5 for four alternating dynamos and eight circuits, and for one arc dynamo and one power generator; Waterloo Electric Co., 1,000-light incandescent plant complete, with wiring for residences, stores, etc., 25-light arc plant complete with long-burning arc lamps, and one marble switchboard; Macgregor, Gourley & Co., Galt, Ont., two power generators, two 8 h.p. motors, two 6 h.p. motors and wiring for incandescent lamps, one marble switchboard panel. Messrs. W. A. Johnson Electric Co. further report that they have also made many sales of their long-burning arc lamps for direct and alternating circuits, chloride accumulators, Wagner transformers, etc.

MCCORMICK TURBINES.

YORK is one of the many noted manufacturing centres in Pennsylvania, and prominent among the manufacturing plants found in that city is that of the S. Morgan Smith Company, whose works were illustrated in our March issue. The buildings are chiefly of stone and brick, and are more than 1,100 feet long, and cover several acres of ground. This plant has been built within the past six years and equipped with new and modern machinery.

The many railroad tracks, travelling cranes and elevators in use upon the premises and within the buildings are so well placed that all articles of machinery manufactured, whether in their crude or finished condition, up to 60,000 pounds weight, are handled as readily as a farmer handles his ploughs upon the farm, or the merchant his goods in the store. The plant is supplied with the latest and most improved machine tools, such as boring mills, pit lathes, shafting lathes, planers and whatever else is needed in the construction of turbine water wheels, iron flumes shafting, pulleys, gearing, steam boilers, etc.—some of the boring mills and pit lathes being large enough to allow of pulleys, rope sheaves and fly-wheels being turned off and bored out, as great as 25 feet in diameter and six feet wide upon their face. There are also some remarkably large and fine machine tools for cutting



and dressing gear wheels up to 20 feet in diameter and as much as 30 inches on the face.

On looking through this shop and noting the many massive and modern tools it contains and the conveniences for handling every article manufactured, one readily understands why it is that the McCormick and New Success water wheels and other machinery for cotton, paper, pulp, flour and saw mills, so extensively built and sold by the S. Morgan Smith Co., give such excellent satisfaction.

The company is composed of father and three sons, who own nine-tenths of the plant. All of them are hydraulic and mechanical engineers, as well as practical business men. These facts explain why it is that the buildings composing the shops are so well constructed and arranged, why all the railroad tracks, travelling cranes, trolley lines, elevators, boilers, engines, cupolas for iron and brass foundries and great lathes and boring mills, are each and all seemingly located just in the right place. An important feature in the plant is the many windows in the ceilings and walls, flooding every department through the day with light, and at night the whole is illuminated with arc and incandescent lights, supplied by the company's dynamos. Large sums have been spent in improving and testing these water wheels, and in this way they know the speed and power of each size of their water wheels so perfectly, that when informed as to what power is needed, and head of water available, they claim never to make a mistake in the size and number of water wheels required to operate the plant to the best advantage.

The McCormick wheel is the invention of John B. McCormick,

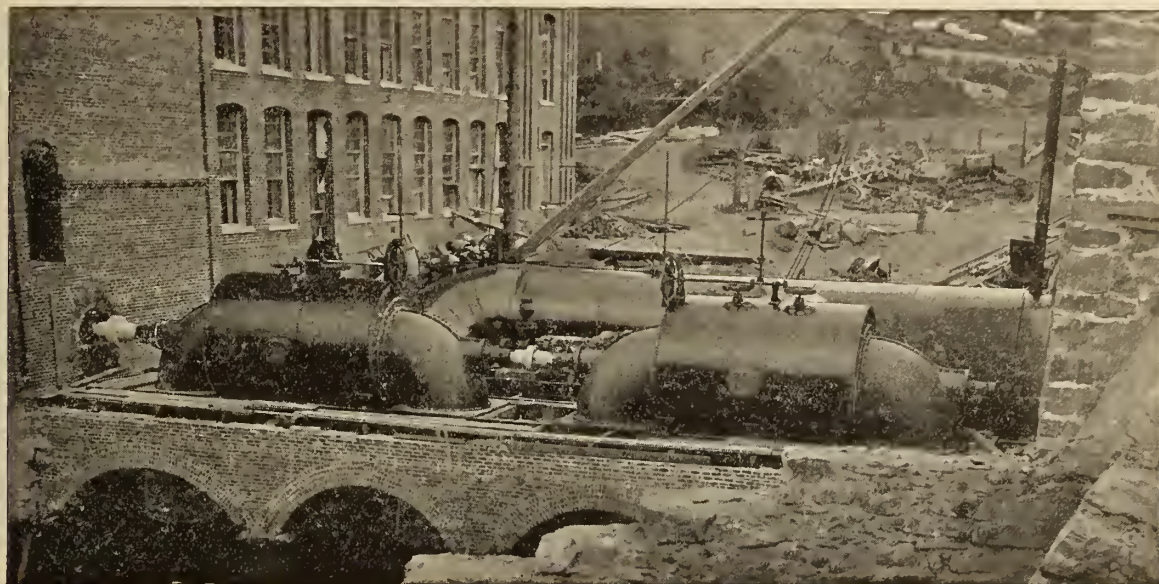
who also invented the Hercules wheel and did much toward the designing of the Victor wheel. The McCormick is his latest invention, and embodies new points of merit in its construction. It is very heavy, strong, well-built and nicely finished. It is a cylinder gate wheel. The gate consists of a ring or cylinder, which is raised or lowered by means of the gate operating device, thus regulating the flow of water to the runner. The guides through which the water passes to the runner are stationary. The gate is balanced, thus making it operate very easily. Hundreds of these wheels are in operation throughout the world, driving all kinds of machinery. A great many have been sold in Canada. The following is a list of some people in Canada who

CORRECTION.

By inadvertence in the advertisement of the Canadian General Electric Company appearing in our April issue, the two 600 horse-power railway generators which they are supplying for Quebec are credited to the Quebec District Railway instead of to the Montmorency Electric Power Company, who are furnishing the power for the system.

PERSONAL.

Mr. F. X. Moisan, president of the Merchants' Telephone Company, Montreal, died in that city last month from paralysis. At a special



This engraving represents two pairs of horizontal 42-inch McCormick turbines, mounted in iron cases on horizontal shafts. They are coupled together, and the power is taken off at one end of the water wheel shaft, which extends into the mill, by three rope sheaves 10 feet in diameter, having 45 grooves for $1\frac{3}{4}$ -inch ropes. There is also a 27-inch McCormick turbine on horizontal shaft, direct connected to a 1,000 gallon fire pump. This turbine also drives the dynamo. The combined power of these turbines is 2,355 horse. The water is supplied to the turbines by two pipes 10 feet in diameter, which are attached to the sides of the wheel cases. The entire outfit was built and erected by the company at the new No. 3 mill of the Clifton Manufacturing Co., Clifton, S. C.

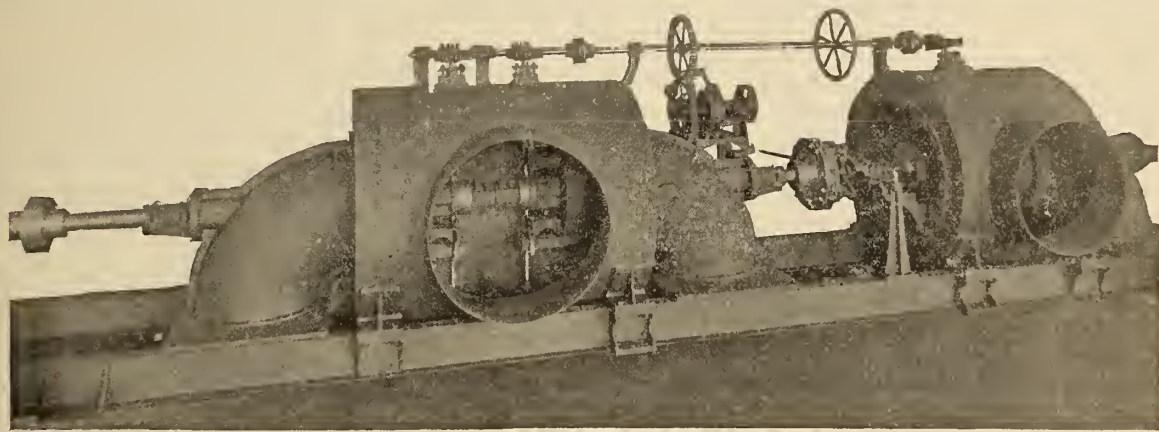
are using McCormick wheels furnished by this company:—Sault Ste. Marie Pulp and Paper Co., Sault Ste. Marie, Ont, 18 vertical 51-inch; E. B. Eddy Co., Hull, Canada, 2 pairs of horizontal 42-inch; Riordan Paper Mills, several different sizes; the Montreal Cotton Co., Valleyfield, Quebec, 2 60-inch, together with gears and shafting, and a duplicate of this order now being built for the same company; municipality of Valleyfield, Que., a 60-inch, together with gears, shafting, friction clutches, etc.; Milton Pulp Co., Milton, Nova Scotia, 4 33-inch; Morgan Falls Pulp Co.,

meeting of the board of directors, resolutions expressing sympathy with the family were passed.

Mr. William Westhead, engineer of the McClary Mfg. Co.'s works at London, Ont., died of apoplexy recently, after a few hours' illness.

Mr. Henry N. Bartlett, inspector of the Ottawa Electric Railway Company, has severed his connection with the company to accept a position in Montreal.

Messrs. James Ross and Granville C. Cunningham, of the Montreal Street Railway Company, returned a fortnight ago from a trip to



This engraving represents one pair and one single 21-inch McCormick turbines, mounted on horizontal shafts in iron cases, operating under 64-foot head, the ice manufacturing plant of Chas. T. Westcott, Baltimore, M. D. By means of the Worrall friction clutch between the pairs and the single wheels, the latter can be disconnected from the former, when it becomes necessary, owing to lack of water, to operate but two wheels. A shaft about 50 feet long is connected with the shaft of the turbines and on the extreme end of it is a rope sheave, from which the power is transmitted to another rope sheave, located in the mill, about 200 feet distant. The water is supplied through a pipe about 125 feet long. The entire outfit was built and placed in position by this company.

New Germany, N. S., 3 33-inch; Sissiboo Falls Pulp Co., Weymouth Bridge, N. S., 1 45-inch, 1 27-inch and 2 33-inch; Farnham Electric Light Co., Farnham, Quebec, 42-inch; G. K. Nesbit, Cowansville, Que., 1 27-inch, etc.

INTERESTING AND USEFUL.

MR. P. H. Dickenson, of the Brantford Electric Company, in renewing his subscription to the ELECTRICAL NEWS, states that he is much pleased with the publication, and finds it very interesting and useful reading.

England. On being asked if there was anything in the report that Canadians would enter new fields of electrical work in England, the latter remarked that these reports were premature, but that if good opportunities presented themselves, he had no doubt that those who were alive to electric railway possibilities in Canada would again go into the business abroad.

It is estimated that a good railway engine will travel about 1,000,000 miles before it wears out. However, the life of an engine depends as to its length upon the treatment it receives. With ordinary care it ought to last twelve years.

INCANDESCENT DYNAMOS.*

By G. W. MACKIE.

We as engineers are often called upon to take charge of a dynamo for shop lighting, therefore I think a little study in this direction will be profitable. Before considering the dynamo, let us see what relation electricity and magnetism bear to each other. If we take a piece of iron (Fig. 1) and wind a few turns of insulated or covered wire upon it, and then pass a current through the wire, we will find the iron magnetized, or having the power to pick up pieces of iron and steel; and the more current we apply the stronger will be the magnetism up to a certain point. But bear in mind that just as soon as the current is stopped the iron loses its magnetism. Then again, if we take two horse shoe mag-

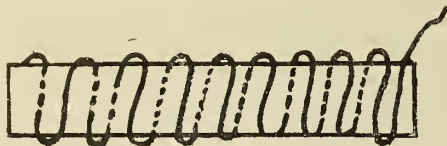


FIG. 1.

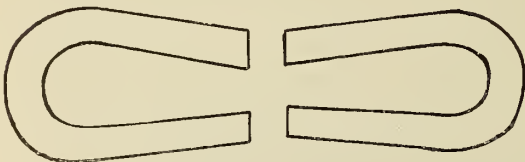


FIG. 2.

nets (Fig. 2) and place them end to end, so that the magnetism will flow from one to the other, then pass a piece of wire rapidly up and down between them, it will become hot from generating a current, thus showing us that electricity and magnetism go hand in hand. The principal parts of a dynamo are as follows, viz., armature, commutator, field magnets and brushes. The armature consists of a drum built up of iron discs, on which are wound coils of wire at right angles to the pole pieces P. The coils, revolving rapidly between the pole pieces, "thereby cutting through the magnetism," generates a current, which is passed out to the commutator. The commutator C is composed of a number of

Resting on the commutator, they carry off the current generated in the armature and pass it into the circuit.

There are two kinds of machines used for incandescent lighting—shunt and compound. In a shunt machine (Fig 3), the current leaves one brush, passes around one field magnet, through a rehostat, or resistance box R, around the other field magnet, back

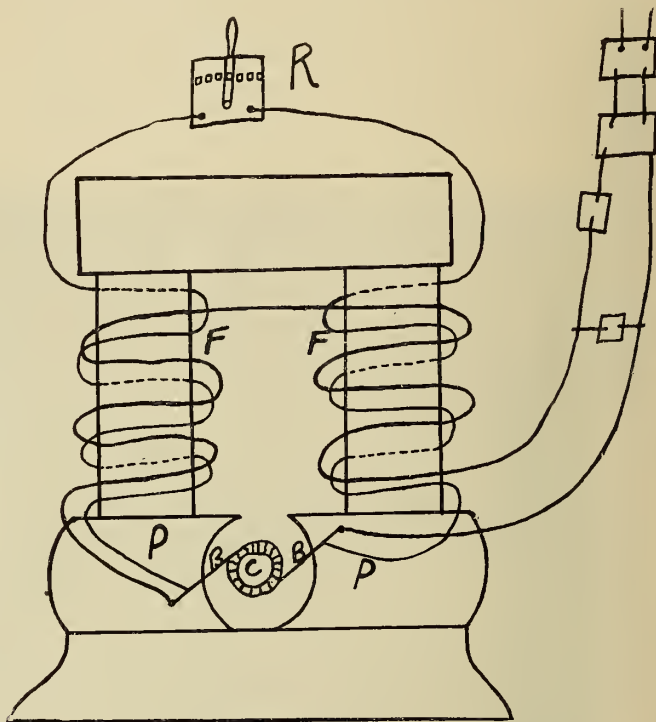


FIG. 4.

to the other brush. To regulate this machine, we move handle of rehostat so as to put more or less resistance to the current flowing in field magnets. This rehostat is composed of a number of coils of German silver wire, "which has a high resistance to the current," and by moving the handle of rehostat we put a greater or less length of this wire in the field wire, thereby varying the resistance. Supposing we were carrying 50 lights, and then added 50 more, we would require more current. To get this extra current we move handle of rehostat so as to cut out some of the resistance, which would let more current flow in the field magnets, making the pole pieces stronger, and the armature, revolving in stronger magnetism, would generate more current. With this machine we would have to regulate for every change of load.

A compound machine (Fig. 4) has the shunt or fine winding the same as the shunt machine, but in addition, has a few turns of heavy or series wire, as shown by the heavy lines (Fig. 4) on field magnets—the light lines showing shunt winding. This heavy or series wire leaves one brush, passes around both field magnets, then to the circuit. With this machine, we bring it up to voltage by rehostat; then it takes care of itself. Whatever current passes to the circuit has first to pass around the field magnets, and the more current flowing to the circuit the stronger will be the magnets. Then again, the less lights we have on the less current will be flowing; thereby the field magnets will be weaker. This machine will regulate itself from full load to no load. In the circuit we have a volt meter, to register voltage or pressure; an ammeter, to give quantity of current flowing; a switch, to open and close the circuit;

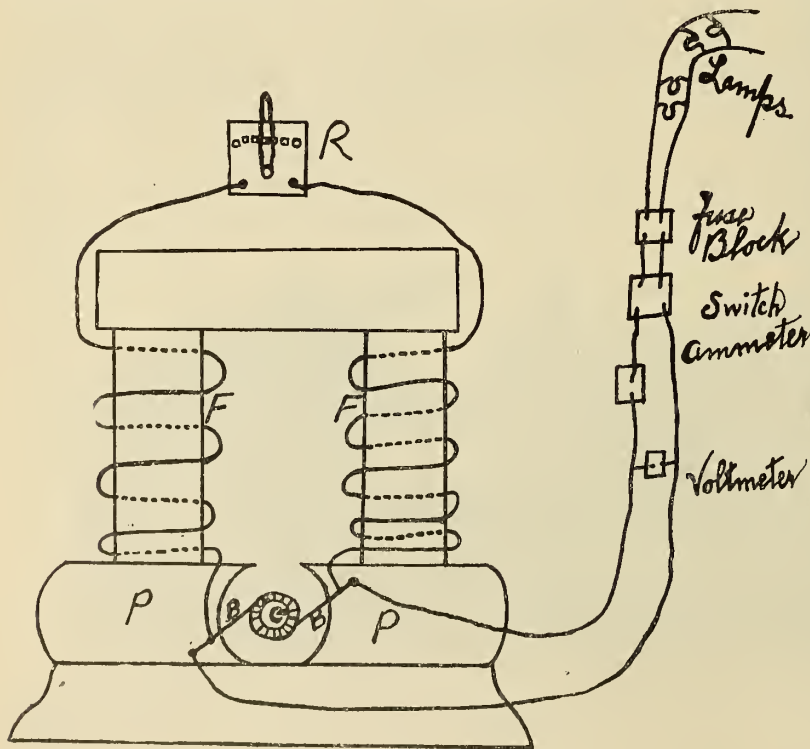


FIG. 3.

bars of copper, insulated one from another. If we had not a commutator, just a plain ring, we would then have an alternating current, but with the use of the commutator we straighten the current so that it will flow in one direction.

Field magnets F is an iron core on which is wound many turns of fine wire, so that when part of the current of the machine passes through this wire it will magnetize them; and the more current we pass through this wire the stronger will be the magnetism of the pole pieces. The brushes B are either copper or carbon.

a fuse block, in which is placed two pieces of soft wire, so that in case of a short circuit or overload, it will burn out this wire and save the machine.

Some of the causes of sparking are:—Carbon brushes becoming glazed, making a poor contact with commutator—this should be sand-papered off; brushes not set at neutral point; brushes not exactly opposite each other; brushes making contact with too many sections of commutator; some of the armature coils short-circuited; rough commutator; copper dust between sections of commutator; loose connection in commutator; machine overloaded.

*Paper read before Hamilton Association No. 2, C.A.S.E.

ELECTRIC RAILWAY DEPARTMENT.

IMPROVED RAILWAY CARS.

THE Toronto Railway Company have in course of construction at their car shops in Toronto twenty open cars, to be known as "Jubilee cars," the intention being to have them ready for operation on the Queen's birthday. They are 27 feet long and seven feet six inches wide, the additional length permitting of more room between the seats. Each car will have a seating capacity for 70 persons, and will be fitted with C. G. E. motors and Blackwell trucks. The sills which support the steps are of Georgia pine, the cross sills and floor of oak, the posts of ash, the seats of maple and cherry, and the roof of cherry and basswood, covered with canvas and coated with fire-proof paint. Iron panels support the seat on each side.

A new feature of these cars will be the double steps at the sides. Bicycle racks will be fitted on the back of each car. The cars will be painted white with a gold finish, and each will weigh about ten tons. The manager of the Street Railway Company considers that these will be the finest open cars in America. It is also the intention of the company to build twenty more open cars and ten large moonlight excursion cars, the latter to be ready by Dominion Day.

LEGAL DECISIONS.

DAVIS VS. OTTAWA ELECTRIC RAILWAY COMPANY.—John Davis, of Ottawa, recovered \$200 damages in an action against the Ottawa Electric Railway Company for being forcibly ejected from a street car because his foot was on an opposite seat and he refused to remove it at the request of the conductor. The railway company appealed from the verdict to the Divisional Court at Osgoode Hall and the verdict was set aside. During the argument an interesting discussion ensued between council and the court upon the right of passengers in railway trains and street cars to put their feet upon the opposite seats. Counsel for Davis contended that if there was room in the car a man with clean boots on had a right to put his feet on the opposite seat. Chief Justice Armour pointed out that this would lead to fine distinctions as to what boots were clean and what were not, and expressed the opinion that he would feel inclined to put a man off the car if he would not take his feet down. It appeared in evidence that Davis had just had his boots cleaned before getting on the car, but the verdict was nevertheless set aside.

CITY OF KINGSTON V. KINGSTON, PORTSMOUTH & CATARAQUI ELECTRIC RAILWAY CO.—Judgment in action tried without a jury at Kingston. The action was brought to compel the defendants to run their cars during the winter months as well as the rest of the year over the portion of the railway from Alfred street along Princess street westward to the city limits, in accordance with the terms of the agreement between the plaintiffs and defendants. Held, that in the face of the line of authorities referred to in the judgment of Ritchie, C. J., in *Backford v. Chatham*, 16 S.C.R., 235, a judgment for specific performance could not be pronounced, because such a judgment would necessarily direct and enforce the working of the defendants' railway under the agreement, in all its minutiae for all time to come. Held also, that the enforcement of a judgment for the performance of a long series of continued acts involving personal service, and extending over an indefinite period, would be equally difficult if the judgment were in the form of mandamus. The plaintiffs were not entitled to the prerogative writ of mandamus, because that writ is not obtainable by action but only by motion. Held also, that to grant an injunction restraining the defendants from ceasing to operate their cars on the part of line in question would be to grant a judgment for specific performance in an indirect form, and that a declaration of right under sec. 52, sub-sec. 5, of the judicature should not be made, as the terms of the contract were plain and were confirmed by statute, and the only difficulty was that of enforcing them. Held lastly, that no evidence of any actual damage having been offered a reference could not be directed. Action dismissed with costs.

SPARKS.

Kirkton citizens are asking for the construction of an electric railroad from London via Bryanson and Granton.

The Cornwall Electric Street Railway Company will probably be given the contract for lighting the streets of Cornwall by arc lights.

It is expected that the electric street railway at Quebec will be in working order early in June. Mr. Evans, manager of the road, has a large staff of men at work.

The Railway Committee of the Dominion parliament have refused to allow the Hull and Aylmer Electric Railway Company to operate their cars on the streets of Ottawa.

The bill to incorporate the Toronto Radial Railway Company, promoted by E. A. Macdonald and Frank Pedley, was thrown out at the recent session of the Ontario legislature.

Messrs. D. B. MacLennan, Q.C., and J. T. Kirkpatrick have been elected directors of the Cornwall Electric Street Railway Co., vice Mrs. H. R. Hooper and Mr. F. N. Seddall, resigned.

Mr. R. H. Fraser, manager of the Toronto and Suburban Electric Railway, is at present in the gold mining regions of the Rainy River district, where he is interested in several claims.

The project of an electric railway from Hamilton to Beamsville, to connect with the H. G. & B. electric road, is still under consideration. Mr. J. S. Campbell is one of the promoters.

A syndicate is still negotiating with Col. Stacey, of St. Thomas, to electrify the street railway in that town. The same parties are said to be considering the construction of an electric railway from London to Port Stanley.

Mr. Auld, of Amherstburg, Ont., has filed plans in Toronto of the proposed railway to be built from Amherstburg to Windsor. A rival company has also filed plans for a similar road, which would indicate that a bitter fight between the two companies might develop.

W. G. Walton, president of the Hamilton & Barton Incline Railway Company, has invented a power transmitter which gives a motor vehicle a speed of from 4 to 24 miles an hour. All the machinery is hung on the frame separate from the body, so that no jar will be felt.

The shareholders of the Montreal Street Railway Company have authorized the directors to issue new stock to the extent of one million dollars, to provide for further expenditure in connection with the extension of the company's lines and the increase of rolling stock, plant, etc.

Mr. D. McDonald, superintendent of the Montreal Street Railway, has received a resolution from the Woman's Club, thanking him for the courtesy with which he received and acted upon their request that stringent measures should be taken to prevent the practice of expectoration in the street cars.

At the last session of the Ontario legislature incorporation was granted to the Ingersoll Electric Radial Railway Company, to construct an electric railway from Ingersoll to St. Marys, Tilsonburg and Brownsville, with power to build telegraph or telephone systems. The capital stock is placed at \$500,000.

The franchise of the Lower Town Street Railway at Quebec has been finally sold to the new electric railway company for the sum of \$20,000. The old company retain their buildings, horses, cars, rails, etc., and have permission to run their cars until the electric road is ready to commence traffic in Lower Town and St. Roch.

The Montreal and Bout de L'Isle Railway Company has secured the contract to carry the mails from Maisonneuve to Longe Pointe, Point aux Trembles and Bout de L'Isle, suburbs of Montreal, the contract in question calling for a service twice a day each way. Two new eight wheeled cars have just been finished for the road by the Ottawa Car Company.

The annual meeting of the Hamilton Radial Electric Railway Company was held at Hamilton on the 5th of April, when a contract was let to extend the road through Burlington to Brant street. The following were elected directors: A. Turner, president; T. Leather, vice-president; J. E. Malloch, managing director; W. A. Wood, treasurer; J. Dixon, George Staunton, T. H. Watson, J. Moody.

The residents of the village of St. Louis du Mile End, a suburb of Montreal, are not satisfied with the service afforded by the Montreal Park and Island Railway, and as a result Mr. Albert E. Lewis, real estate agent, has entered an action against the village claiming \$50,000 damages from the corporation for not compelling the railway company to provide a more efficient service. The plaintiff claims that his property has been depreciated in value by lack of speedy transportation.

EDUCATIONAL DEPARTMENT

INTRODUCTORY

After mature deliberation the publisher of this journal has decided to devote a certain amount of space each month to what may be termed an Educational Department, wherein both mechanical and electrical formula and mathematical problems will be discussed, illustrated, and as far as possible rule and example given. At the request of the editor, I have with pleasure undertaken to contribute to this department regularly each month, and before discussing actual mathematical problems, wish to briefly introduce the subject at issue.

The primary object of this department is chiefly to increase the value of an already valuable paper, by placing in the hands of every engineer who has any knowledge of the rudimentary principles of mathematics, such matter as will enable him by a little study to master the most intricate mechanical and electrical formula. Many of our most valuable engineering works and publications from time to time contain formula that is in many cases but vaguely understood, and very often entirely misunderstood, thus rendering an otherwise valuable work practically valueless to the reader.

Just at what particular point our calculations should commence became a matter of serious thought, and past experience had to be carefully considered, bearing in mind the fact that there are many really good engineers whose early education has, through force of circumstances, been deficient, and many others who, through lack of opportunity, have not been able to review their early education for years. Knowing by observation and experience the great necessity of having a thorough elementary education before attempting to digest and calculate problems, and the almost utter impossibility of the student arriving at a satisfactory conclusion of his studies without a thorough knowledge of the principle of mathematics involved, I have decided to commence at a point and carry out the programme outlined in this journal—commencing at the foundation and advancing by easy stages until the principles underlying the most obtuse and difficult formula can be readily explained and easily understood. The advantages to be derived from an education of this kind, coupled with practical mechanical ability, is too well understood to require comment.

The programme which has been outlined for the succeeding nine months will embrace:

DECIMAL FRACTIONS—Definitions and explanation of principles of, and method of reduction to common fractions, and vice versa.

SQUARE AND CIRCULAR MEASURE—Definition and explanation and practical demonstrations of.

CUBICAL AND CYLINDRICAL MEASUREMENTS—Definitions and explanations of, with practical hints.

SQUARE AND CUBE ROOT—Definitions and explanations of.

SAFETY VALVE CALCULATIONS—(Spring and Lever Types)—Principles of, with practical demonstrations.

BOILER CONSTRUCTION—Stays, rivets, joints and seams, iron and steel plate—strength of, with formula and practical demonstrations.

It is not the intention to fill these columns with a mass of figures hastily compiled without reference to any particular object; on the contrary, every problem will be carefully thought out, and only such information given as will be of use to you, and an effort will be made, based on experience and a knowledge of the requirements, to make this series of tests complete in every particular.

WM. THOMPSON.

COMMON FRACTIONS.

A FRACTION is one or more of the equal parts into which a unit, or that which is considered as a whole, may be divided.

[NOTE.—Thus a two foot rule is divided into $\frac{1}{4}$, $\frac{1}{2}$, $\frac{3}{4}$, $\frac{1}{8}$, $\frac{1}{16}$, and so on, and consequently this style of numeration is constantly occurring in mechanical engineering.]

The terms of a fraction are styled and distinguished as the Numerator and the Denominator.

The numerator of a fraction indicates the number of parts of the unit considered or taken.

The denominator indicates the number of parts into which the unit is divided.

To express a fraction is to indicate by figures the number of parts in the numerator and denominator respectively above and below a horizontal line.

Thus $\frac{1}{8}$, $\frac{1}{4}$, $\frac{1}{2}$.

Common Fractions are known as Simple, Compound and Complex.

A simple fraction is a fraction whose numerator and denominator consist of simple numbers.

Thus $\frac{1}{4}$, $\frac{1}{2}$, $\frac{1}{8}$, $\frac{1}{16}$.

A compound fraction is a fraction whose value is not fully expressed, but must be arrived at by computation.

Thus $\frac{1}{2}$ of $\frac{1}{16}$, $\frac{1}{8}$ of $\frac{1}{4}$, etc.

A complex fraction is one which contains a fraction in the numerator or denominator, or in both. Its value must be found by computation.

Thus $\frac{\frac{1}{2} \text{ of } 6}{\frac{2}{3} \text{ of } 1}$ $\frac{\frac{1}{2} \text{ of } \frac{1}{16} \text{ of } 4}{\frac{1}{2} \text{ of } 6}$

The numerator or figures above the line correspond with the dividend, and the denominator or figures below the line with the divisor.

The chief principles relating to fractions are:

1. Multiplying the numerator by any number multiplies the fraction.
2. Multiplying the denominator by any number divides the fraction.
3. Dividing the numerator by any number divides the fraction.
4. Dividing the denominator by any number multiplies the fraction.
5. Multiplying both numerator and denominator by the same number does not affect the value of a fraction.
6. Dividing both numerator and denominator by the same number does not affect the value of a fraction.

Giving us the important general principle that any change in the numerator produces a corresponding change in the value of the fraction, and any change in the denominator produces an opposite change in the value of the fraction.

COMMON DENOMINATOR.

A common denominator is a denominator which is common to two or more fractions.

Rule: To find a common denominator to two or more fractions, multiply together all the denominator and the product will be the common denominator.

Example: Find common denominator of $\frac{1}{2}$, $\frac{2}{3}$, $\frac{3}{4}$, $\frac{1}{8}$ = The denominators multiplied together, as $2 \times 3 \times 4 \times 8 = 320$, which becomes the denominator common to the whole of these fractions.

This rule often entails a lot of work, consequently I prefer to

reduce denominators to their simplest form and multiply together the final quotient and the divisors, which will give the common denominator in lowest form.

Example: Find the common denominator of

$\frac{1}{8}$, $\frac{2}{3}$, $\frac{1}{16}$, $\frac{3}{4}$, $\frac{1}{2}$

Reduce denominators to lowest form, thus:

$$\begin{array}{r} 3 \overline{) 6 \cdot 8 \cdot 32 \cdot 3 \cdot 5} \\ 2 \overline{) 2 \cdot 8 \cdot 32 \cdot 1 \cdot 5} \\ 4 \overline{) 1 \cdot 4 \cdot 16 \cdot 1 \cdot 5} \\ \hline 1 \cdot 1 \cdot 4 \cdot 1 \cdot 5 \end{array}$$

Then by multiplying final quotient and divisors together, thus, we get

$$5 \times 1 \times 4 \times 1 \times 4 \times 2 \times 3$$

Since, however, single units do not in any way effect results we write it

$$5 \times 4 \times 4 \times 2 \times 3 = 480 \text{ C. D.}$$

Rule: To reduce two or more fractions to equivalent fractions having a common denominator, divide the common denominator by the denominator of the given fraction, multiply the quotient so found by their numerators, and write the results over the common denominator.

Reduce to equivalent fractions having a common denominator.

$\frac{1}{8}$, $\frac{2}{3}$, $\frac{1}{16}$, $\frac{3}{4}$, $\frac{1}{2}$

Since we have just found the common denominator of these fractions to be 480 we place it thus

$$\begin{array}{r} 400 \quad 420 \quad 225 \quad 320 \quad 384 \\ \hline 480 \end{array}$$

and proceed as in rule to divide the common denominator by the denominator of the first of our fractions, $\frac{1}{8}$, which equals $480 \div 6 = 80$. Proceeding again as by rule, we multiply this product by the numerator, 5, thus $80 \times 5 = 400$, which result we place in first position above the common denominator. Proceeding similarly with the other fractions in our example, we get a series of fractions having a common denominator and equivalent to the fractions from which we started computation.

ADDITION OF FRACTIONS.

Addition is the process of finding the sum of two or more fractions.

Principle involved: Fractions to be added must be reduced to equivalent fractions having a common denominator.

Rule: To find the sum of two or more fractions having different denominators, reduce the given fractions to equivalents with a common denominator. Add the numerators so found, and if their sum is greater than the common denominator divide the numerator by the common denominator and the result will be the sum of the given fractions.

Find the sum of $\frac{1}{16}$ + $\frac{7}{8}$ + $\frac{3}{4}$ + $\frac{1}{2}$.

Proceeding as before we find the common denominator to be 16, thus

$$\begin{array}{r} 4 \overline{) 16 \cdot 8 \cdot 4 \cdot 2} \\ 2 \overline{) 4 \cdot 2 \cdot 1 \cdot 2} \\ \hline 2 \cdot 1 \cdot 1 \cdot 1 = 16 \end{array}$$

Proceeding exactly as before we find the equivalent fractions having a common denominator to be expressed thus:

$$\frac{5 + 14 + 12 \times 8}{16 \text{ C. D.}} = \frac{119}{16}$$

Adding these numerators together, as in rule, we get the

fraction $\frac{3}{16}$. Now dividing the numerator 39 by the denominator 16 we get $39 \div 16 = 2\frac{7}{16}$, then our question may be expressed thus :

$$\frac{5}{16} + \frac{7}{8} + \frac{3}{4} + \frac{1}{2} = \frac{5+14+12+8}{16} = \frac{39}{16} = 2\frac{7}{16}$$

This principle underlies the whole subject of addition, and needs no further demonstration.

SUBTRACTION OF FRACTIONS.

Subtraction of fractions is the process of finding the difference between two fractions.

Principle involved: Fractions, to be subtracted, must be reduced to equivalents with a common denominator.

Rule: To find the difference between two simple fractions, reduce the fractions to equivalents having a common denominator and subtract the numerators, and reduce the result to its simplest form.

Find the difference between $\frac{7}{8}$ and $\frac{1}{16}$.

Proceeding as already described in addition of fractions, we get

$$\frac{7}{8} - \frac{1}{16} = \frac{15-1}{16} = \frac{14}{16} = \frac{7}{8}$$

It will be observed that the process is exactly similar to the process of addition, and exceedingly simple, requiring practically no explanation when we have mastered the principles.

MULTIPLICATION OF FRACTIONS.

Multiplication is the process of finding the product of two factors, one or both of which may be fractions.

Rule: To multiply a fraction by a fraction, multiply the numerators together and also the denominators, and reduce to simplest form.

Multiply together $\frac{1}{2} \times \frac{1}{2}$. Proceeding as per rules and multiplying the numerators together and the denominators likewise, we get

$$\frac{1}{2} \times \frac{1}{2} = \frac{1 \times 1}{2 \times 2} = \frac{1}{4}$$

Following out the principle set forth in clause 6 of our introduction, multiply together

$$\frac{1}{8} \times \frac{3}{8} \times \frac{7}{8} \times \frac{1}{16}$$

Following out this principle we proceed by a process of cancellation to reduce to simplest form, thus

$$\frac{1}{8} \times \frac{3}{8} \times \frac{7}{8} \times \frac{1}{16} = \frac{21}{64}$$

By applying this system of cancellation, based upon the principle set forth in clause 6, you will observe we materially shorten the process of calculation without in any way affecting the result.

Rule: To multiply a fraction by an integer or an integer by a fraction,

1. Divide the denominator of the fraction by the integer and place the result under the numerator, and reduce to simplest form, or

2. Divide the integer by the denominator of the fraction, and multiply the result by the numerator, or

3. Multiply the numerator of the fraction by the integer and place the result over the denominator. (See clauses 1 and 4 of principles).

Example (employing 1st method):

$$\text{Multiply } \frac{3}{8} \times 8 = 32 \div 8 = 4 = 4\frac{0}{8} = 4$$

Example (employing 2nd method):

$$\text{Multiply } \frac{3}{8} \times 64 = 64 \div 8 = 8 \times 3 = 24$$

Example (employing 3rd method):

$$\text{Multiply } \frac{5}{8} \times 8 = \frac{40}{8} = 5$$

It will be observed that the first of these methods can only be employed when the integer can be divided into the denominator an equal number of times, and the second when the denominator can be divided into the integer similarly, and the third method can be used at any time, but when either of the other methods can be used, lengthens the process, as is evidenced by calculation in this case. Employing method 1 and embracing principle 6, calculation would have been made as follows:

$$\frac{5}{8} \times 8 = 5$$

DIVISION OF FRACTIONS.

Division of fractions is the process of finding the quotient when either dividend or divisor is a fraction or mixed number, or when both dividend and divisor are fractions or mixed numbers.

Rule: To divide a fraction by an integer, divide the numerator or multiply the denominator of the fraction by the integer. The result will be the quotient. (See principles, clauses 2 and 3).

Example: $\frac{3}{8} \div 9 = \frac{3}{72} = \frac{1}{24}$

Rule: To divide an integer by a fraction, multiply the integer by the denominator of the fraction and divide the product by the

numerator, or divide the integer by the numerator and multiply the quotient by the denominator.

Example (by 1st method):

$$\text{Divide } 100 \div \frac{3}{4} = 400 \div 3 = 133\frac{1}{3}$$

Example (by 2nd method):

$$30 \div \frac{3}{4} = \frac{120}{3} = 40$$

Rule: To divide a fraction by a fraction, multiply the numerator of the dividend by the denominator of the divisor and set down the product as a new numerator, then multiply the denominator of the dividend by the numerator of the divisor and set down the product as the new denominator—reduce new fraction to simplest form, or

Invert the terms of the divisor and proceed as in multiplication of fractions.

Example: Divide $\frac{7}{8} \div \frac{3}{4}$ (following 1st rule). Since numerator of dividend is 7 and denominator of divisor 4, we get $7 \times 4 = 28$, which becomes new numerator or dividend.

Since denominator of dividend is 8 and numerator of divisor 3, we get $8 \times 3 = 24$, which becomes new denominator or divisor and giving $\frac{28}{24} = 1\frac{1}{3}$, that is, $\frac{3}{4}$ is contained in $\frac{7}{8}$ $1\frac{1}{3}$ times.

Employing 2nd method:

$$\frac{7}{8} \div \frac{3}{4} = \frac{7}{8} \times \frac{4}{3} = \frac{28}{24} = 1\frac{1}{3}$$

Again employing 2nd method and applying clause 6 of principles:

$$\frac{7}{8} \div \frac{3}{4} = \frac{7 \times 4}{8 \times 3} = \frac{28}{24} = 1\frac{1}{3}$$

It occasionally occurs in computation of formula that a fractional part of a fraction requires to be divided by a fraction or a fractional part of a fraction.

Rule: To divide a compound fraction by a compound fraction, first reduce the compound fraction to a simple fraction, and then follow rule laid down for dividing a fraction by a fraction.

Example: Divide $\frac{1}{2}$ of $\frac{7}{8}$ by $\frac{3}{4}$ of $\frac{1}{16}$.

To reduce compound fractions $\frac{1}{2}$ of $\frac{7}{8} \times \frac{3}{4}$ of $\frac{1}{16}$ to simple fractions, proceed as in multiplication of fractions.

Then $\frac{1}{2}$ of $\frac{7}{8} = \frac{1}{2} \times \frac{7}{8} = \frac{7}{16}$, and $\frac{3}{4}$ of $\frac{1}{16} = \frac{3}{4} \times \frac{1}{16} = \frac{3}{64}$; then question becomes a simple matter, since we proceed exactly as in division of fractions from this point.

Since dividend $\frac{1}{2}$ of $\frac{7}{8} = \frac{7}{16}$,

Since divisor $\frac{3}{4}$ of $\frac{1}{16} = \frac{3}{64}$,

$$\text{we get } \frac{7}{16} \div \frac{3}{64} = \frac{7}{16} \times \frac{64}{3} = \frac{28}{3}$$

SPARKS.

An electric light plant will probably be installed at the consumptive sanitarium at Gravenhurst, Ont.

The Halifax Tramway Company have placed a large order for G. E. 1,000 equipments with the Canadian General Electric Company.

Mr. D. C. Dewar, recently manager of the Bell Telephone Company at Ottawa, was presented with a gold watch by the employees before his departure for Montreal.

The Hull Electric Company have placed an order for two 300 k.w. generators and several additional G. E. 1,200 and G. E. 51 equipments with the Canadian General Electric Company.

The Lachine Rapids Hydraulic & Land Company, of Montreal, have decided to issue \$750,000 of debentures. It was stated at a special meeting that one thousand horse-power of current had been sold to the Standard Light and Power Company.

Plans have been submitted to the Ontario and Dominion governments for the construction of a dam and lock across Ash Rapids, in the Lake of the Woods. It is proposed to utilize the water power so provided in generating electricity to light the mines and drive the power drills in the vicinity.

The Canadian General Electric Company have been awarded the contract for a 1,000 light incandescent plant by the corporation of Port Arthur. The plant, which is now being installed, will be of their standard single phase alternating type, and will be in operation in the course of two or three weeks.

Mr. E. J. Lennox, architect, has reported to the City Council of Toronto regarding the establishment of an electric plant at the new city buildings. He estimates that 700 horse power will be required to light the buildings, and 200 horse power for running the electric elevator. Should the plant be placed at the waterworks it would necessitate an extra boiler, while if placed at the buildings the exhaust steam could be utilized.

The Hamilton Radial Electric Railway Company are extending their system in the direction of Oakville. They have ordered four 45 ft. passenger cars from the Crossen Car Company, of Cobourg, which are to be models in every respect. These cars will each be equipped with a four motor equipment of G. E. 1000 motors, for which an order has been placed with the Canadian General Electric Company. These four motor equipments are guaranteed to have a speed of 38 miles an hour, but with acceleration on the level will easily make from 45 to 50 miles, thus making the Burlington line, by long odds, the highest speed electric road in the Dominion.

SPARKS.

An electric light plant will probably be installed by the village of Exeter, Ont.

The Huntsville electric light plant, installed by the Canadian General Electric Co., was recently put in operation.

The Canadian General Electric Company have installed a direct-current lighting and power plant for Messrs. Bertram & Sons, Dundas, Ont.

The Finance Committee of the Hamilton City Council have passed the by-law for the conversion of the Hamilton and Dundas railway into an electric system.

The Canadian General Electric Company have sold a 1,000 light standard alternator to the Full Electric Light Company, Charlottetown, P. E. I.

The Montreal Island Belt Line Railway Company have ordered additional G. E. 1,000 and G. E. 1,200 equipments from the Canadian General Electric Company.

Mr. Fred Parkin, electrician for the Canada General Electric Co., Toronto, returned lately from River du Loup, Que., where he installed a new incandescent system.

Mr. J. Seguy, of Quebec, has invented an apparatus, one part of which is placed on the inside and the other on the outside of steam boilers in order to economize heating. It can be applied to all old boilers.

The Galt, Preston and Hespeler Railway Company have placed an order for an additional G. E. 1200 equipment with the Canadian General Electric Company.

A new electric railway company has been formed at Niagara Falls, Ont., composed of H. C. Symmes, R. Paine and others. It is proposed to construct a line which will connect with the Niagara Falls Park and River Railway and extend to Lundy's Lane battle ground.

The Consolidated Railway Company of Vancouver, B. C., have placed a large order for G. E. 1000 motors with the Canadian General Electric Company.

The 1,000 light standard alternator purchased by the corporation of Huntsville from the Canadian General Electric Company, was put in successful operation last week.

The town of Thorold has purchased the incandescent electric light system from Mr. McGill.

The Stadacona Water, Light and Power Company, of Huntingdon, P. Q., ordered a 60 k.w. 1,000 light standard alternator from the Canadian General Electric Company.

A new electric light company has been formed in Aylmer, Ont., to be known as the Aylmer Electric and Manufacturing Company, Ltd. The directors of the company are: Hugh McDiarmid, Daniel C. Davis, John Simpson, all of Aylmer, and Jos. W. Campbell and W. H. Irving of Toronto. Extensive improvements and additions are to be made to the present plant.

The Hamilton, Grimsby and Beamsville Railway Company have purchased G. E. 1,200 equipments from the Canadian General Electric Company for the improved freight and express services which they are about to commence. Their intention is to load C. P. R. express cars with fruit, along the line, and draw them over to the T. H. & B. road for carriage to Toronto and other points.

The Brockville Electric Light Company are making extensive improvements in their incandescent lighting plant. They have placed an order with the Canadian General Electric Company for a 100 k.w. monocyclic alternator of their new 125 cycle type. The use of 125 cycles in this case was rendered necessary by the fact that the old transformers, of which between three and four thousand lights capacity were installed, were unsuited for operation on a lower frequency.

Patents have recently been granted for Canada as follows: Canadian General Electric Co., Toronto, dynamo; Wm. Smith, Sheldon, Iowa, rotary steam engine; James and Emery Caldwell, Auburn, N. Y., turbine water wheel; E. J. Armstrong, Oswego, N. Y., crank disk for steam engines; C. P. Choquette and Antoine M. Morin, St. Hyacinthe, Que., acetylene generator; A. C. Fraser, Brooklyn, N. Y., process for generating acetylene; A. M. Scott, Hamilton, acetylene gas apparatus; John E. Friend, Lambton Quay, New Zealand, steam boiler; G. H. and M. G. Broder, Winchester, Ont., journal bearing; R. S. Hill, Detroit, valve for steam engine; General Electric Co., Schenectady, N. Y., electric brake; insulation of electric cable, Max Guillaume, Mulheim-on-the-Rhine, Germany; The Stilwell-Bierce & Smith-Vaile Co., Dayton, Ohio, electric water wheel governor; Bell Telephone Co., Montreal, multiple switchboard spring jack; Franz L. Barthelmes, Toronto, wood pulley.



Manufacturers of

FINE VARNISHES

Japans—Asphalts—Shellacs

Maple Leaf Brand Coach Varnishes

J. H. FARR & CO.

Armature Insulating Compound

Insulating Compound for Weather-Proof Wire, Tube
Compound, Mica Paste, etc., etc.

6 TO 16 MORSE STREET
TORONTO





The electric light company at Rat Portage, Ont., are putting in new generators for arc lighting and power.

The Hamilton Street Railway Company have placed an order for G. E. 1,200 motors with the Canadian General Electric Company.

The Canadian General Electric Company have furnished 10 additional G. E. 1000 motors to the Kingston, Portsmouth and Catarqui Railway Company.

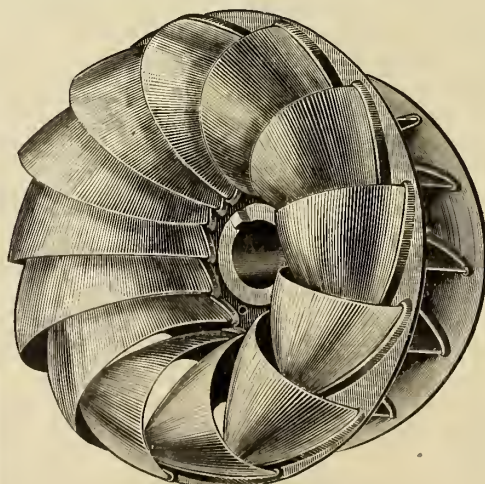
George White & Sons, Limited, London, Ont., are seeking incorporation as manufacturers of steam engines, boilers and other machinery, with a capital of \$170,000.

The Electrical Construction Company, of London, Ont., has been incorporated, to take over the business of the London Electric Motor Company. The capital stock is \$45,000.

F. E. Harvey, doing business as the Citizens Telephone Exchange, Waterloo, Que., is reported to have assigned, with liabilities of \$12,000. The estate will probably pay fifty cents on the dollar.

The Canada Permanent Loan and Savings Company have awarded the contract for a 500 light direct-connected incandescent plant, for the Clarendon Hotel in Winnipeg, to the Canadian General Electric Co.

WATER POWER CROCKER TURBINE



The above Engraving illustrates the Runner Removed from Case.

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For Electric Lighting

Ensures Steadiness,
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WHEELS FULLY TESTED AT
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SHERBROOKE, QUE.

SPARKS.

An addition has been built to the electric light works at Newmarket, Ont.

C. J. Edgar, M. D., is putting in an electric plant at North Hatley, Que.

Dr. C. J. Edgar is putting in an electric plant at Magog, Que., for street lighting.

The ratepayers of Picton, Ont., will be asked to provide funds to increase the electric light plant.

The town of Dartmouth, N. S., will submit a by-law to the ratepayers to raise \$50,000 with which to purchase the present electric light plant.

Mr. George White-Fraser, of Toronto, recently had a conference with the authorities at Magog, Que., regarding a proposed electric plant.

The town council of Owen Sound has engaged Mr. Jas. C. Kennedy, C. E., to prepare a plan and specification for a new contract for streetlighting, also to furnish an estimate of the value of the electric light plant of the company now supplying the street arc lights, and also to furnish an estimate of the cost of putting in an entirely new electric plant by the town. In the meantime tenders are asked for lighting the streets by arc lights for a term of 5 or ten years.

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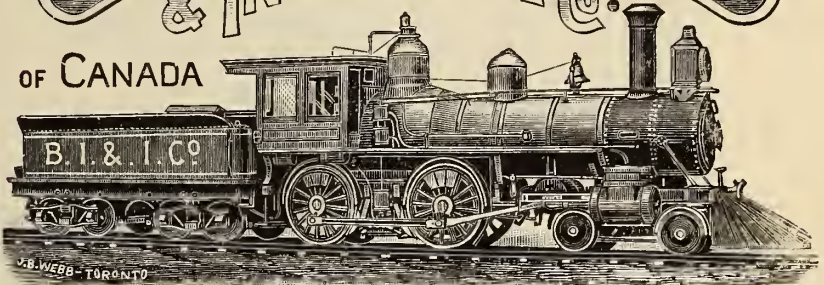


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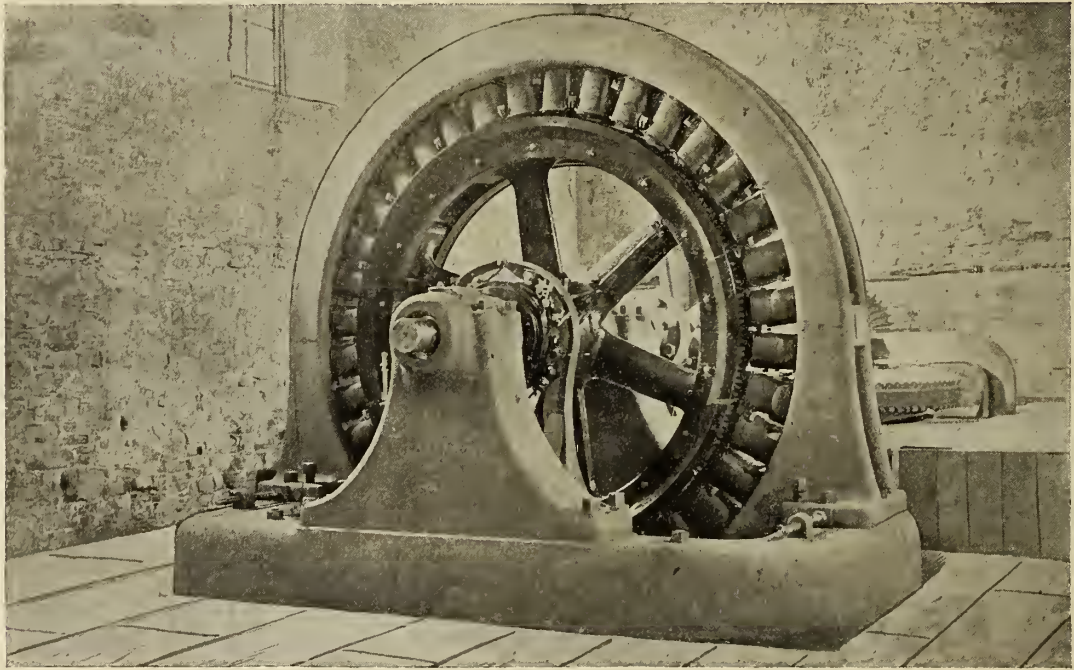


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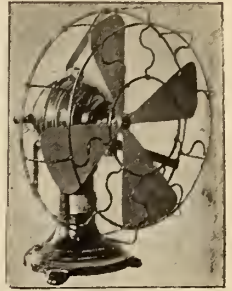
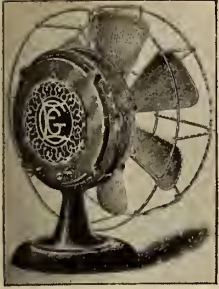
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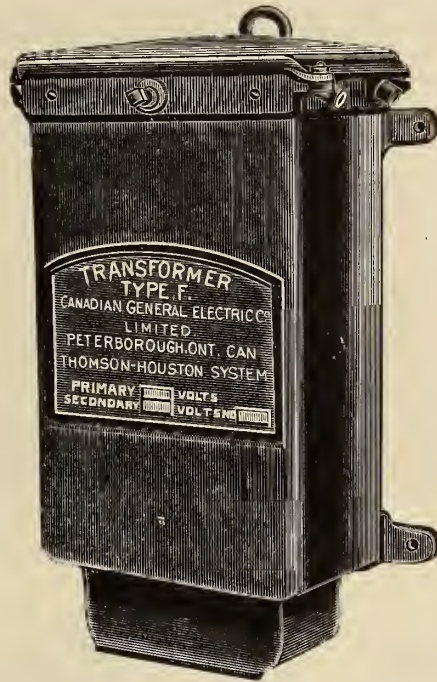
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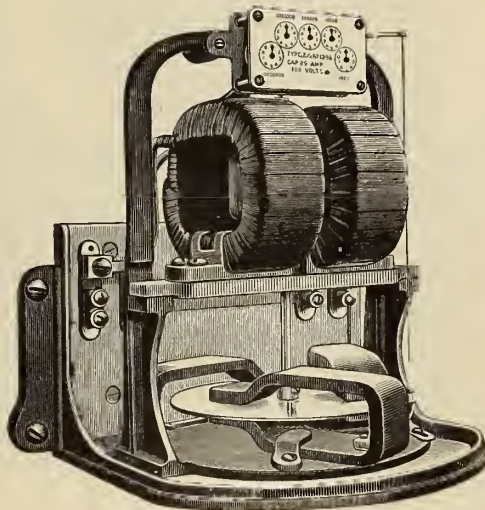
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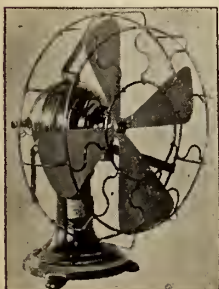
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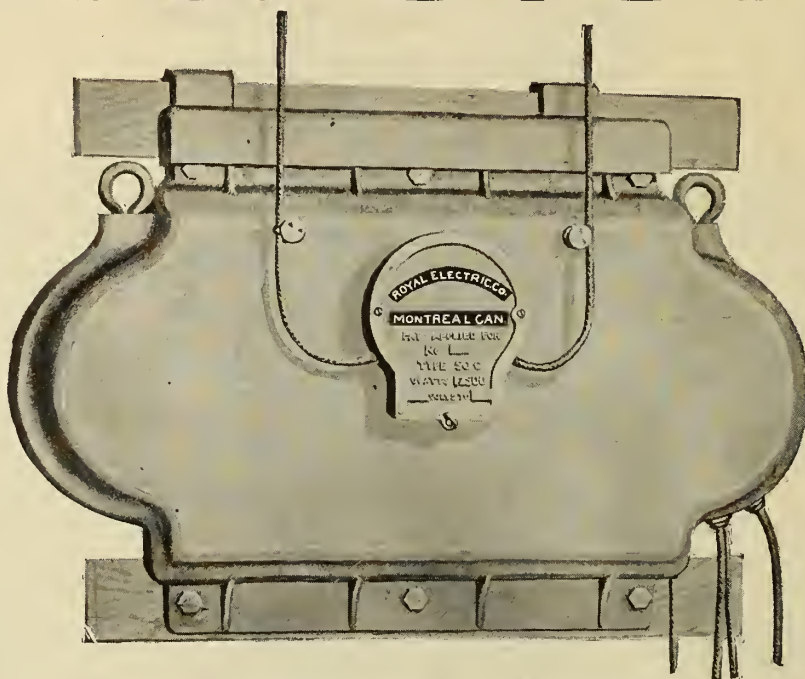
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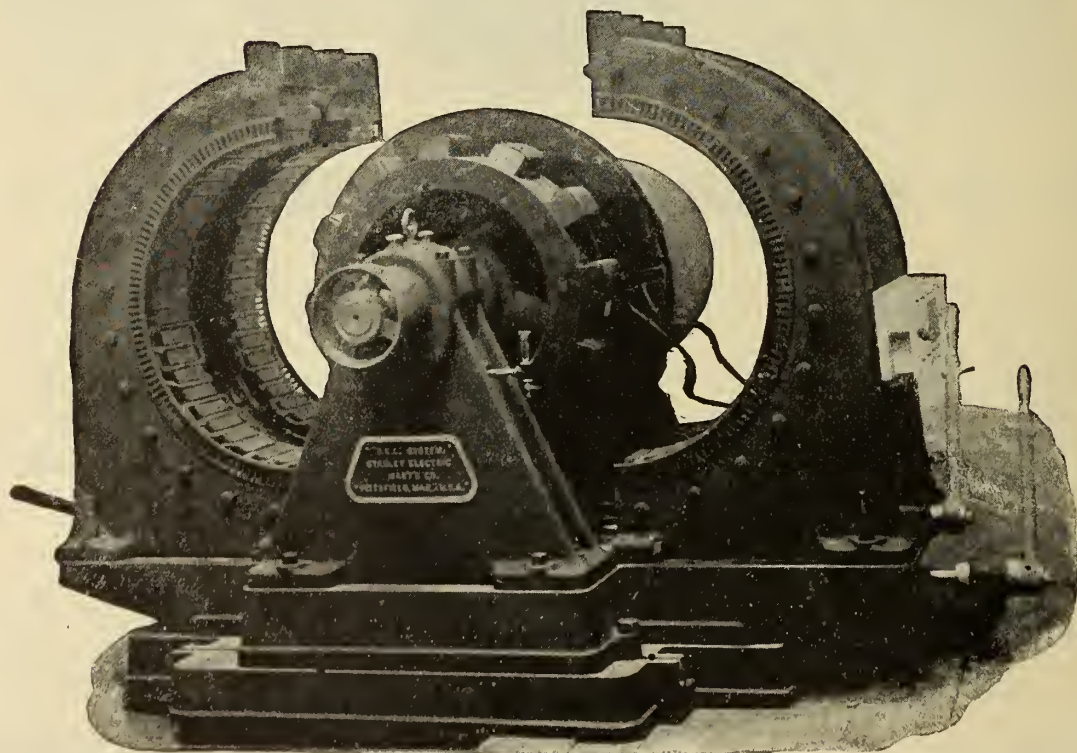
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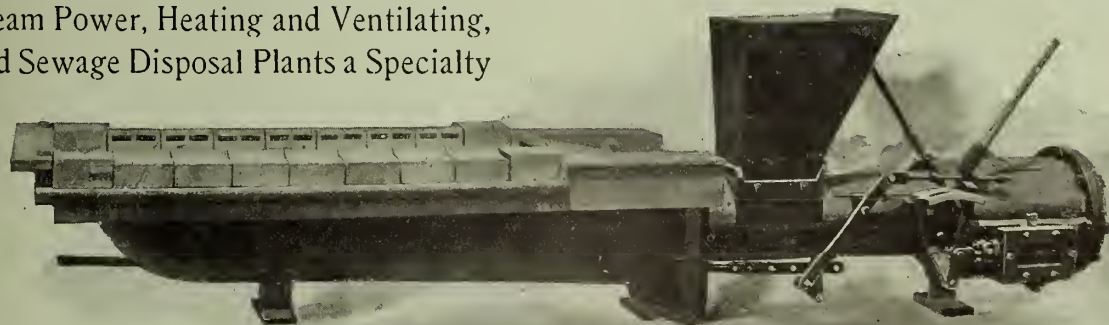
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CANADIAN

ELECTRICAL NEWS

STEAM ENGINEERING JOURNAL

OLD SERIES, VOL. XV.—No. 6.
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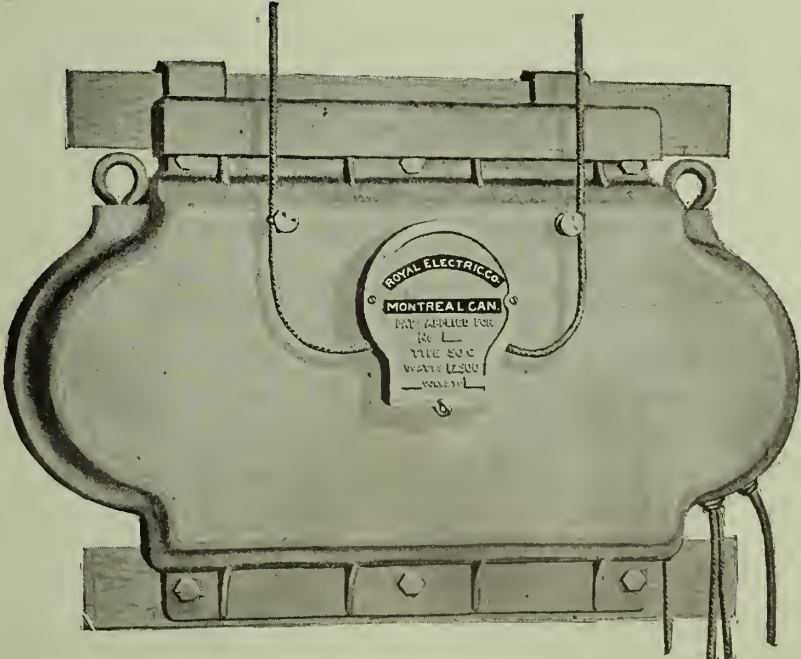
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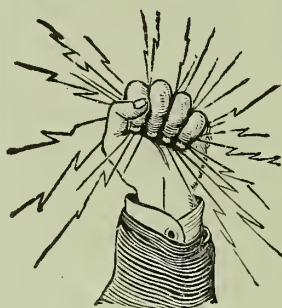
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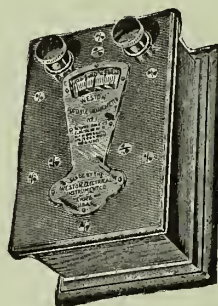
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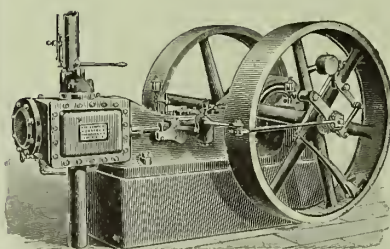
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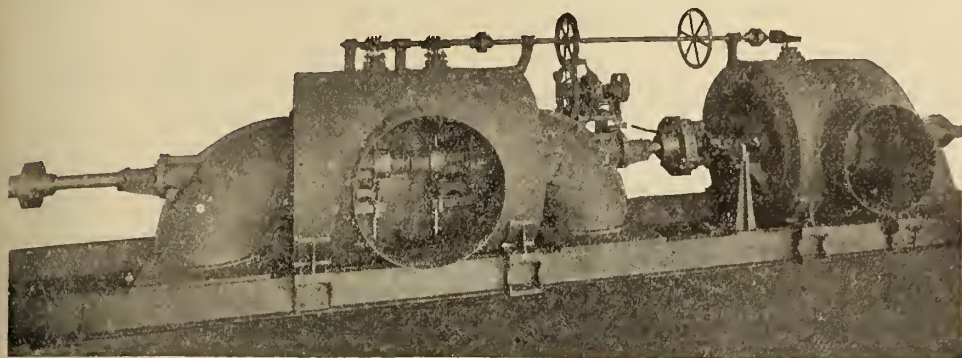
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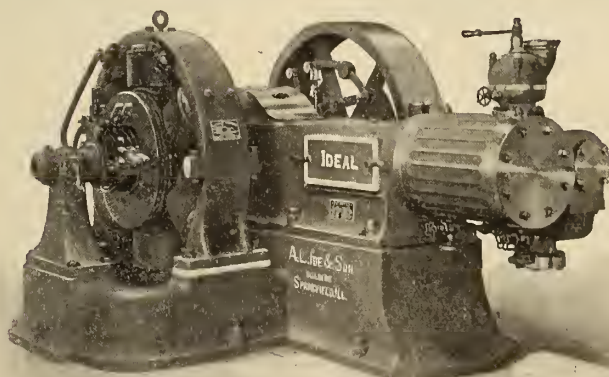
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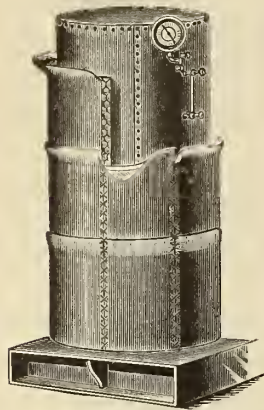
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CANADIAN
ELECTRICAL NEWS
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VOL. VII.

JUNE, 1897

No. 6.

SARNIA GAS AND ELECTRIC LIGHT CO.

WE print herewith an illustration of the power station of the above company, accompanied by a few particulars descriptive of the equipment of the same.

The building is of red brick, with freestone trimmings and stone foundation, with basement under the engine room, having truss roof covered with iron, making the building practically fireproof. The size of the structure is 34 x 72, with an octagon brick smoke stack 75 feet high. The foundations for engine, dynamos and line shafting are of stone and brick set in cement, reaching through the main floor.

The steam plant consists of a Wheelock engine 13 x 30, boiler 60" x 14', 84 3" flues, with all necessary shafting and pulleys, manufactured by the Goldie & McCulloch Co., of Galt.

The electric plant was built during the summer of

electrician. Accompanying this article are portraits of these two gentlemen.

QUESTIONS AND ANSWERS.

SUPERINTENDENT writes: "In a 2,080 volt monocyclic dynamo or in any other machine, does it not have a bad effect upon the armature to have the commutator short-circuited to a more or less extent? I claim that it not only has a bad effect upon the stationary shunt, but also upon the rotating shunt and armature. Am I right or not, please? Would the short-circuiting of the commutator cause the armature to finally burn up altogether? Another question—Supposing I carry on my 'secondaries' a voltage of 118 and then reduce it to 112 volts, what candle-power would I be getting from a 50 c. p. incandescent lamp? How is it computed? and is there any table or book published upon this ques-



Mr. Wm. Williams.



THE SARNIA GAS AND ELECTRIC WORKS.



Mr. Geo. Shand.

1894, and consists of one 75 light Wood arc dynamo with spare armature, a 30 kilowatt T.H. alternator with 1½ k.w. exciter, with the usual switchboard apparatus. The electrical plant was installed by the Canadian General Electric Company.

The arc line for public lighting required over 16 miles of No. 6 wire and ten miles of poles, feeding sixty-two 1200 c.p. lamps. Over 600 lamps are wired up for incandescent lighting in the town.

In order to further increase the capacity and efficiency of the plant, during the past summer a 300 h.p. Northey duplex condenser and a duplex boiler feed pump were installed, taking water supply from the river through an 8-in. pipe. These improvements add easily 25% to the economy and efficiency of the plant. It is contemplated to further increase the plant by adding an additional boiler and a larger alternator during the year.

Mr. Wm. Williams is the manager of the business, the success of which is largely due to his enterprise and good judgment. He has an able assistant in the person of Mr. Geo. Shand, the chief engineer and

tion? Are not electric wires apt to become "grounded" by passing through branches of trees, especially in constant wet weather? How could you tell if they were grounded if you had no ground detector? Could you tell by 'bell-tests'? How are series incandescent lamps connected up in connection with a direct current arc circuit? If you will be so kind as to answer these questions in your next issue, I will, I am sure, feel obliged."

ANSWER.—(1) In any generator the short-circuiting of the commutator, if a D.C. machine—or the collector rings, if an alternator—will result in a burnt armature. If the "commutator" in the above question means the two-part commutator used in the series field, then short-circuiting it will, in the first place, have the effect of (a) cutting out the compounding coils, leaving the machine as though it were merely separately excited; or (b) depending on the method of connecting in the two parts, might have the effect of sending an alternating current round the series coils; and in the second place would (a) cause heat, which might injure the armature. (2) Supposing your 50 c. p. lamp was intended to give that at 118 volts,

then reducing the pressure to 112 would probably reduce the c. p. to about 40 c.p. There is a theoretic method of calculating the reduction of candle power, depending on several specific quantities, such as resistance of filaments, specific incandescence, etc., which is too complicated; it is sometimes stated that variations of 1% in voltage cause variation of 5% in c.p. Ram's book on incandescent lamps is good. (3) Wires are liable to be grounded against branches. (4) A magnet bell will usually disclose the presence of a ground. (5) Just like arc lamps, in series.

A. S. P. writes: "Will you kindly give me some information on the Grant Bramble rotary steam engine, of Sleepy Eye City? I would like to know whether the wheel will rotate when steam is admitted into the chamber, as it is claimed it will."

ANSWER.—The engine will certainly rotate, but the mere fact of it doing this is no evidence of its becoming in any way a superior motive power. As a matter of fact there is not a single point in its favor that will recommend it to a practical engineer. Mr. Bramble has been getting a lot of fine advertising and has produced nothing that is in anyway useful to the engineering world—certainly not an economical rotary engine.

THE STEAM BOILERS ACT.

THE above is a title of a bill now before the Dominion parliament to provide for the examination of stationary engineers and the inspection of steam boilers, the promoters being the members of the Canadian and Ontario Associations of Stationary Engineers. It is improbable that the bill will pass the House at the present session but it is hoped to make such advancement as will ensure its success next year. Below are given the chief provisions of the act:

The Governor in Council may appoint a chief inspector of steam boilers and not fewer than eight inspectors for the purpose of carrying out the provisions of this act, and the said chief inspector and inspectors shall constitute a board to be known as the Board of Steam Boiler Inspection.

No person shall be appointed a member of the board who has not at least five years' experience as a practical engineer, and who does not hold a high class certificate from some incorporated body or government board, showing that he is a person possessed of practical knowledge of the structure and operation of steam boilers.

The inspectors shall meet under the direction of the chairman for the purpose of making regulations subject to the approval of the Governor in Council and not inconsistent with the provisions of this act:—(a) For holding annual or special examinations, to be conducted by the board or any member thereof, of persons from time to time applying under this act; (b) for granting certificates of qualification to persons passing such examination; (c) for regulating the manner of operating steam boilers and the methods to be adopted for securing the safety thereof; (d) for providing for the uniform inspection of steam boilers, the tests to be used on such inspection, and the circumstances under which such inspection shall be made.

Every person not duly registered under this act, who, after the day of one thousand eight hundred and ninety eight, operates any steam boiler, or is in charge of any steam boiler while in operation, whether as owner or as engineer, shall be liable, on summary conviction, to a penalty of not less than dollars and not more than dollars.

Every person who, at the date of the passing of this act, has been for two years engaged in the operation of steam boilers, upon producing a certificate of his uniform good conduct and sobriety from the owners by whom he has been employed during the said period, and also from some responsible person not connected with the business of such owners and a resident in the municipality or in each of the municipalities in which such boilers

have been so operated, or a holder of a certificate from any incorporated body or from any province, shall be entitled, upon making an application to the chairman of the board on or before the first day of January, 189 , and upon payment of dollars to the chairman, to receive a certificate of qualification and to be registered under the provisions of this act.

Any candidate who considers he has been unfairly dealt with by any of the inspectors, or whose certificate has been revoked, may appeal, in writing, to the chairman of the board, setting forth such grievance; and the chairman shall at once investigate such charge, calling in two of the inspectors to assist him; and their decision shall be final.

In case any owner of a steam boiler shows, to the satisfaction of the chairman, that he is unable, by reason of some unforeseen occurrence, to immediately secure the services of a duly qualified person to operate such boiler, the chairman or other inspector to whom such application is made may grant a permit to any person producing satisfactory evidence of good conduct and sobriety to operate such boiler for a period of sixty days from the date of application, and in such case no penalty shall be incurred by reason of operating such steam boiler pending the granting of such permit.

Every owner of a boiler shall cause it to be inspected at least once in each year by an inspector appointed under this act. The inspector making such inspection shall forward a copy of his record thereof to the chairman, who shall immediately forward a certificate of inspection to the owner. Such certificate shall be produced upon demand by the chairman or any inspector under this act. For such certificate the owner of the boiler shall pay a fee of dollars.

The provisions of this act respecting the inspection of boilers shall not apply to any boiler insured and inspected by any duly incorporated boiler insurance company doing business in Canada, but the owner of such boiler shall, when required by any inspector under the provisions of this act, produce the certificate of inspection from such company.

PERSONAL.

Mr. W. B. Close has succeeded Mr. R. H. Fraser as manager of the Toronto and Suburban Electric Railway.

Mr. M. J. Sullivan, for many years with the Great Northwestern Telegraph Company at Toronto, has accepted a responsible position in New York.

Mr. A. Smith, of Kingston, has been appointed district superintendent for the Bell Telephone Company for the territory lying between Kingston and Windsor.

Mr. F. C. Wanklyn, who lately became manager of the Toronto street railway, has been appointed superintendent of the Montreal street railway pro tem during the absence of Mr. Granville Cunningham in Birmingham, where the latter will assist Mr. James Ross in the conversion of the road there into an electric railway.

Before leaving for the mining districts of Northwestern Ontario, Mr. R. H. Fraser, manager of the Toronto & Suburban Electric Railway, was tendered a banquet at Occidental Hotel, Toronto Junction. After the banquet the street railway employees waited upon Mr. Fraser and presented him with a gold-headed cane, on which was inscribed, "To R. H. Fraser, Esq., by the employees of Toronto Suburban Street Railway, April 30, 1897."

Judgment has been given at Montreal maintaining the injunction of the Bell Telephone Company against that city. The City Council in November last passed a resolution instructing the city engineer to prevent the petitioner from opening the streets. The court holds that the charter of the Bell Telephone Company gives it the right to make the necessary excavations in the streets to lay its wires underground, and enjoins the city from interfering.

Messrs. Achille Gagnon & Co., of Victoriaville, Que., who began in December last furnishing incandescent light to the towns of Victoriaville and Arthabaskaville, have found it necessary to increase their plant, owing to the rapid increase of their lighting. They have placed their order for a 75 k.w. S. K. C. two-phase alternator with the Royal Electric Company of Montreal, as it is their intention to furnish power as well as light from the same generator and circuit. Their first installation was single-phase alternating, but finding that they could also secure some power business during the day, they decided to operate their plant 24 hours per day, and for this purpose secured an S. K. C. two-phase machine, from which they can serve both light and power from the same line.

CONVENTION SPARKS.

[From Souvenir Number ELECTRICAL NEWS, C.E.A. Convention.]

It was a case of "Put me off at Buffalo."

Did we hear you ask "where are we at?" At the end of three days of solid enjoyment.

What a good thing for the farmer hereabouts that the time is not yet, seeing that the lady bicyclist is abroad in the land.

Notwithstanding the plentiful supply of water in this neighborhood, last night's banquet was a "corker," or rather un-"corker."

To-day we shall have the privilege of seeing the biggest thing on earth in the way of electrical enterprise. The next time we come we hope to see a duplicate of it on this side of the river.

As the result of his vigilant observation since last convention, will Mr. Milne tell us what is the latest prank developed by electric light meters? We want, if possible, to be in a position to head them off.

How does this convention illustrate the fact that our holiday seasons differ from those of our cousins across the herring pond? Give it up? Because we hear Carroll-ing in June instead of December. See?

Have you observed a change in appearance of the rainbow at the Falls since this convention assembled? Seems as though Black and Browne are the predominating colors, before whose lustre the other tints are dim.

It is reported that Mr. A. B. Smith has intimated his willingness to prepare a paper for next convention on "How to Keep Sub-Aqueous Cables in Working Condition," based upon recent experience at Sarnia and elsewhere.

Glad to see some Blue-Noses amongst us on this auspicious occasion. They have set us an example of cosmopolitanism which we would do well to imitate. Who knows but we may ere long have a convention down by the sounding sea?

Was it but the whistling wind, or our fancy, or did we actually hear, wafted on the breeze from Queenston, the strains of

"A life on the ocean wave,
And a home on the rolling deep?"

Perhaps friend Kammerer might be prevailed upon to give DeCew to seekers after franchises regarding the means employed to smooth down the opposition humps on the backs of the Hamilton aldermen. Will Mr. Kammerer turn on the X rays.

The man who asked that the ladies be excluded from the banquet on the ground that the embarrassment occasioned by their presence would cause him to forget his speech, is asked to appear for sentence at the Ladies' Headquarters, Hotel Lafayette, City.

This looks like a case of bearding Acetylene Gas in its den. It is to be hoped that notwithstanding the combination of acetylene gas and other kinds of gas and electricity prevailing hereabouts at present, there will be no explosions. We look to Bro. Wickens to keep the safety valve properly adjusted.

So far as the visitors to this convention are concerned, the popularity of Wilfrid Laurier pales into shadowy insignificance beside that of Wilfred Phillips, the good-looking manager of the Niagara Falls Park and River Railway, to whose indefatigable efforts much of the success of the present occasion is due. In the language of the Montreal contingent, Vive le Wilfred!

You may all know by this time that there has been

"A chiel amang ye takin' notes,"

but you may not be aware that the camera fiend, in the person of "Joe" Wright, has been quietly on the lookout for snap-shots since this Convention began. I may possibly have the privilege later on of letting you

"See yersel's as ithers see ye."

Did you ever listen to Mr. J. J. Wright as he discourses upon the beauties of agricultural life in comparison with the job of the man who finds himself in charge of a big lighting and power station? If not,

there are flights of enthusiasm and oratory which you may yet enjoy. The experiences of the last few months are said to have perfected Mr. W.'s ability to prove the affirmative of the proposition that the farmer has a picnic without apparently being conscious of his advantages.

As Canadians we feel at liberty to express ourselves in language more emphatic than polite regarding some of the work of the American law makers. We don't always see eye to eye with the Yankee government, but of the individual Yankee we have the highest possible opinion. The manner in which the visitors to this convention have been treated by our friends across the gorge shows them to be out and out "white men." In fact we think so much of them that we hope to annex more and more of them individually in the future.

MECHANICAL ENGINEERS' ASSOCIATION.

THE Mechanical Engineers' Association of the province of Quebec was organized as a separate body in the year 1894, before which time its members were associated with the Canadian Association of Stationary Engineers. The object of the association is not only to insure for its members benefits in case of sickness or



MR. E. F. VALIQUET.

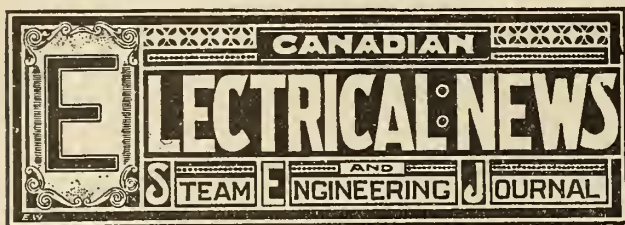
death, but also to give them the necessary technical instruction. Lectures are given semi-monthly by outside specialists, or by members of the union. By an intelligent administration this society, though having paid large sums of money to sick members, has to-day a good surplus. The election of its officers for the year 1897 took place on the 20th April, with the following result: President, E. F. Valiquet; 1st vice-president, H. Beauchamp; 2nd vice-president, M. Guimond; treasurer, W. Gendron; financial secretary, E. Leroyer; recording secretary, A. Belair; assist-



MR. H. BEAUCHAMP.

ant recording secretary, Jos. Gingras; corresponding secretary, A. Tessier; introducer, A. Habig; door-keeper, O. Tontaine; trustees, M. U. Lessard (president), E. Brisbois, A. Provost, J. Langevin, F. Lavigne, N. Despatie, Jos. Verdon; delegates to Central Council, E. Brisbois, M. Guimond; examiners, R. Drouin, E. F. Valiquet, H. Denis.

The new officers were installed on the 4th of May. Portraits of the president and vice-president appear herewith. The former is chief mechanical engineer at Rutherford & Sons' saw mills, which position he has occupied for the past five years.



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SUBSCRIPTIONS.

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Subscribers may have the mailing address changed as often as desired. When ordering change, always give the old as well as the new address.

The Publisher should be notified of the failure of subscribers to receive their paper promptly and regularly.

EDITOR'S ANNOUNCEMENTS.

Correspondence is invited upon all topics legitimately coming within the scope of this journal.

The "Canadian Electrical News" has been appointed the official paper of the Canadian Electrical Association.

CANADIAN ELECTRICAL ASSOCIATION.

OFFICERS:

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JOHN YULE, Manager Guelph Light & Power Company, Guelph, Ont.

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CHAS. B. HUNT, Manager London Electric Co., London, Ont.

2ND VICE-PRESIDENT:

J. A. KAMMERER, General Agent, Royal Electric Co., Toronto.

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A. B. SMITH, Superintendent G. N. W. Telegraph Co., Toronto.

A. A. DION, Ottawa Electric Co., Ottawa.

F. A. BOWMAN, New Glasgow, N. S.

WILFRED PHILLIPS, Manager Niagara Falls Park and River Railway, Niagara Falls, Ont.

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WILLIAM THOMPSON, Superintendent Waterworks and Electric Light Plant, Montreal West, Que.

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Secretary, W. F. CHAPMAN,	Brockville, Ont.
Treasurer, R. C. PETTIGREW,	Hamilton, Ont.
Conductor, J. MURPHY,	Montreal, Que.
Door Keeper, F. J. MERRILL,	Ottawa, Ont.

TORONTO BRANCH NO. 1.—Meets 1st and 3rd Wednesday each month in Engineers' Hall, 61 Victoria street. John Fox, President; Chas. Moseley, Vice-President; T. Eversfield, Recording Secretary, University Crescent.

MONTREAL BRANCH NO. 1.—Meets 1st and 3rd Thursday each month, in Engineers' Hall, Craig street. President, John Murphy; 1st Vice-President, J. E. Huntington; 2nd Vice-President, Wm. Smyth; Secretary, B. Archibald York; Treasurer, Peter McNaughton.

ST. LAURENT BRANCH NO. 2.—Meets every Monday evening at 43 Bonsecours street, Montreal. R. Drouin, President; Alfred Latour, Secretary, 305 Delisle street, St. Cunegonde.

BRANDON, MAN., BRANCH NO. 1.—Meets 1st and 3rd Friday each month in City Hall. A. R. Crawford, President; Arthur Fleming, Secretary.

HAMILTON BRANCH NO. 2.—Meets 1st and 3rd Friday each month in Maccabee's Hall. Wm. Norris, President; E. Teeter, Vice-President; Jos. Ironside, Corresponding Secretary, Markland St.

STRATFORD BRANCH NO. 3.—John Hoy, President; Samuel H. Weir, Secretary.

BRANTFORD BRANCH NO. 4.—Meets 2nd and 4th Friday each month. J. B. Forsyth, President; Jos. Ogle, Vice-President; T. Pilgrim, Continental Cordage Co., Secretary.

LONDON BRANCH NO. 5.—Meets on the first and third Thursday in each month in Sherwood Hall. G. B. Risler, President; D. Campbell, Vice-President; Wm. Meaden, Secretary-Treasurer, 533 Richmond street.

GUELPH BRANCH NO. 6.—Meets 1st and 3rd Wednesday each month at 7.30 p. m. H. Geary, President; Thos. Anderson, Vice-President; H. Flewelling, Rec.-Secretary; P. Ryan, Fin.-Secretary; Treasurer, C. F. Jordan.

OTTAWA BRANCH NO. 7.—Meet every second and fourth Saturday in each month, in Borbridge's hall, Rideau street; Frank Robert, President; T. G. Johnson, Secretary.

DRESDEN BRANCH NO. 8.—Meets 1st and Thursday in each month. Thos. Steeper, Secretary.

BERLIN BRANCH NO. 9.—Meets 2nd and 4th Saturday each month at 8 p. m. J. R. Urley, President; G. Steinmetz, Vice-President; Secretary and Treasurer, W. J. Rhodes, Berlin, Ont.

KINGSTON BRANCH NO. 10.—Meets 1st and 3rd Thursday in each month in Fraser Hall, King street, at 8 p. m. President, F. Simmons; Vice-President, J. W. Tandy; Secretary, A. Macdonald.

WINNIPEG BRANCH NO. 11.—President, G. M. Hazlett; Rec.-Secretary, J. Sutherland; Financial Secretary, A. B. Jones.

KINCARDINE BRANCH NO. 12.—Meets every Tuesday at 8 o'clock, in McKibbin's block. President, Daniel Bennett; Vice-President, Joseph Lighthall; Secretary, Percy C. Walker, Waterworks.

PETERBOROUGH BRANCH NO. 14.—Meets 2nd and 4th Wednesday in each month. W. L. Outhwaite, President; W. Forster, Vice-President; A. E. McCallum, Secretary.

BROCKVILLE BRANCH NO. 15.—Meets every Monday and Friday evening, in Richards' Block, King St. President, Archibald Franklin; Vice-President, John Grundy; Recording Secretary, James Aikins.

CARLETON PLACE BRANCH NO. 16.—Meets every Saturday evening. President, Jos. McKay; Secretary, J. D. Armstrong.

Canadian Electrical Association.

OUR readers will no doubt find much to interest them in the proceedings of the recent convention of the above Association, published in this number. It is gratifying to state that the attendance was satisfactory, and more thoroughly representative of the whole Dominion than on the occasion of any previous meeting. A large addition was made to the membership of the Association, principally from the ranks of central station owners and managers. The papers were quite up to the standard of former years, and covered a wide range of subjects. The discussions were far in advance of those at any previous convention both as regards the free expression of opinion and amount of practical information elicited. Central station practice properly received a large measure of consideration, and as a result many central station men were heard to express their appreciation of the benefits to be derived from connection with the Association and attendance at the convention. The reference in the president's address to the necessity of legislation for the protection of the rights of those who have invested their capital in the electric lighting business, and the subsequent action taken thereupon, indicate a determination to make the Association of practical value in conserving the interests of its members and of the electrical industries of the country. In this laudable endeavor it should receive the hearty support of all whose interests are bound up with these industries. The reelection of Mr. Yule was a fitting recognition of the zeal and success with which he has sought to promote the welfare of the organization, and under his guidance good results may be looked for in the year to come. It is to be regretted that Mr. L. B. McFarlane felt compelled, on account of pressure of other duties, to decline to again accept office in the Association. He has been a valued aid to the work of the Association in the past, and it is to be hoped may at a later date re-enter the harness. His successor, Mr. C. B. Hunt, is a gentleman of recognized business ability, and will be a source of much strength to the organization, while Mr. Kammerer, second vice-president, lacks neither the ability nor opportunity to enable him to advance its welfare. The executive committee comprises men of ability, and, we are pleased to say, is representative not only of Ontario and Quebec, but of the maritime provinces as well. In view of these and other favorable conditions, friends of the Association may reasonably look forward to a year of great prosperity and usefulness, culminating in a convention at Montreal in 1898 which will eclipse in interest even the successful event at Niagara Falls last week.

CANADIAN ELECTRICAL ASSOCIATION

PROCEEDINGS OF THE SEVENTH CONVENTION, AT NIAGARA FALLS, ONT.



THE Seventh Annual Convention of the Canadian Electrical Association took place at the Dufferin Cafe, Niagara Falls, Ont., on the 2nd, 3rd and 4th of June, 1897. It was one of the most largely attended and interesting in the history of the Association. There was a noticeable increase in the

attendance of central station men from various parts of the Dominion.

A meeting of the Executive Committee was held in the forenoon of the first day, at which twenty-five new members were elected. The first session opened at 2.30 o'clock, the President, Mr. John Yule in the chair.

There were present the following persons :

K. J. Dunstan.....	Toronto, Ont.
Frederic Nichols.....	"
J. J. Wright.....	"
C. H. Mortimer.....	"
Geo. A. Wilkie.....	"
E. K. M. Wedd.....	"
Irving H. Smith.....	"
A. A. Christie.....	"
A. B. Smith.....	"
J. A. Kammerer.....	"
W. A. Johnson.....	"
A. M. Wickens.....	"
W. J. Clarke.....	"
E. D. McCormick.....	"
W. H. Bourne.....	"
Albert Esling.....	"
T. F. Dryden.....	"
James Milne.....	"
F. H. Leonard, jr.....	"
J. W. Campbell.....	"
Jos. Wright.....	"
E. B. Biggar.....	"
John C. Gardner.....	"
Ross McKenzie.....	"
John Yule.....	Guelph, Ont.
W. H. Browne.....	Montreal, Que.
John Carroll.....	"
Wm. Thompson.....	"
J. A. Bayliss.....	"
C. B. Hunt.....	London, Ont.
C. E. A. Carr.....	"
Capt. Williams.....	"
F. Pepler.....	Barrie, Ont.
Stephen Noxon.....	Ingersoll, Ont.
G. E. Gayfer.....	"
Henry Comstock.....	Brockville, Ont.
Geo. Shand.....	Sarnia, Ont.
Wm. Williams.....	"
John Murphy.....	Ottawa, Ont.
B. F. Reesor.....	Lindsay, Ont.
H. O. Fisk.....	Peterboro', Ont.
E. E. Cary.....	St. Catharines, Ont.
Geo. A. Powell.....	"
James Lamont.....	Chatham, Ont.
Geo. Phemister.....	Niagara Falls, Ont.
Wilfred Phillips.....	"
G. E. Foster.....	"
E. T. Freeman.....	Halifax, N. S.
V. B. Coleman.....	Port Hope, Ont.
John Farley.....	St. Thomas, Ont.
F. A. Bowman.....	New Glasgow, N. S.
J. W. Purcell.....	Walkerville, Ont.
W. H. Bullard.....	Seaforth, Ont.
C. H. Philbrook.....	Buffalo, N. Y.
H. E. Adams.....	"
W. J. Johnston.....	New York, N. Y.
Wm. McCullough.....	"
Geo. Black.....	Hamilton, Ont.
W. F. McLaren.....	"
F. W. Martin.....	"
Gordon J. Henderson.....	"
B. J. Throop.....	"
Thos. Wadland.....	"
Q. C. Baker.....	"
Thos. Duncan.....	Fort Wayne, Ind.
C. J. Page.....	Welland, Ont.
J. M. Brown.....	Carleton Place, Ont.
Chas. E. Taylor.....	Sault Ste. Marie, Ont.

The President, after welcoming the members to the convention, read the following address :

PRESIDENT'S ADDRESS.

GENTLEMEN :—Once more the Canadian Electrical Association is convened for the transaction of business. Our place of meeting is at this particular time singularly appropriate, the whole district being an object lesson to those engaged in electrical enterprises. The progress of electrical science during the last few years is very fully exemplified in the various undertakings it will be our privilege and pleasure to examine during our meeting. I will, therefore, not take up your time with any remarks on the progress of development in the various branches of applied electricity.

The programme prepared will, I hope, meet with your approbation. The papers to be read are of interest to all, and the valuable information therein contained when carried home and put into practice will realize good financial results, and should be value for every dollar expended in attending this meeting.

Allow me to emphasize that this organization is not for the display of intellectual gymnastics, but to provide an occasion when all can meet on common ground and feel no hesitation in propounding questions or expressing views; every one is a member with equal privileges, entitled to and sure to receive respectful recognition. I therefore urge upon all to take an active part in the discussions. Surely in this gathering there can be culled sufficient information to repay every one of us for the time given to attend.

The different items mentioned in the programme for social enjoyment kindly provided by our friends here and on the other side of the river, will afford a treat not often enjoyed by us, and will, I trust, give members an opportunity of becoming better acquainted with one another. No business jealousies should find a place amongst us, rather ought we to help each other by exchanging opinions and experiences, and particularly should this be the case just now, when so many are face to face with that movement now prevalent in Canada for what is called municipal control. Many lighting companies during the past year have had to fight for the prevention of ruin to their enterprises. I, for one, can speak from personal experience. This question appears to me to be to lighting companies the question of the hour. Repeated repulses does not seem to stay the movement. It is gathering strength and some means will have to be devised to prevent the wiping out of a very large amount of capital legitimately invested in the electric lighting business. We look back and remember the inducements, encouragement and praise that were given to those venturing their savings in the business—in most cases done for the purpose of improving their town and helping their community to keep up with the march of progress—and compare therewith the now vehement attacks of local agitators, and even reputed respectable newspapers who din in the ears of the ratepayers the marvellous success and saving effected in a few large and rapidly growing cities in the old land, entirely oblivious to the conditions existing in the smaller cities, towns and villages of Canada. We hear of Glasgow, Manchester and Birmingham, where the civic ambition largely prevails amongst men of capital, leisure and ability, who give their time and talents to promote the common good. The late Governor-General of Canada, the Earl of Derby, is now serving as mayor of a large English city; while municipal affairs in Canada are managed in odd hours snatched from business, by men who cannot afford to give the time and attention necessary to the successful management of an intricate and hazardous mercantile concern like the supply of electricity. They also do not know or forget that municipal control was not introduced in England in the vicious way it is carried out in this land, by using the taxable resources of the ratepayers to ruin what was, at one time, by the same people, lauded as creditable enterprise on the part of their fellow citizens. It is not my purpose to enter into an elaborate argument why municipal control is not a success in Canada. The agitation is in the air and how best to save our property from complete confiscation is the question of primary importance. We do not dispute the right of municipalities to control and operate all their franchises, if honestly and fairly entered into. I hope that our Legislature will realize it to be their duty to provide for the compulsory purchase and transfer of properties where the local authorities decide to assume control of the lighting service, and prevent money invested by our citizens in necessary and laudable enterprises from being wantonly wasted. It is a hopeful sign that a few of our leading newspapers are now recognizing that the practice in some European countries of government control of monopolies is the true remedy for any evils that may exist. The Toronto Globe in dealing with the telephone question admits this principle in

pointing out the mistake that would be made, and the injury to the public which would follow, should a second telephone company be permitted to enter into business in Toronto. Quite recently the same paper quoted approvingly from a paper on "Monopolies and the People," where the author tersely sets forth the evils of the popular attitude towards competition projects:—

"Let a proposition to build a competing railroad line or a competing electric light plant be submitted to popular approval and, under the impression that they are benefitting themselves, hard-working men will cheerfully assume heavy burdens of taxation to aid the new enterprise. So blind and unreasoning indeed is this popular abiding faith in the merits of competition, that it has been responsible for some of the greatest wastes of wealth in unproductive enterprises that have ever been known."

In Great Britain the government forbids by legislative enactments local authorities entering into competition with private companies, but makes it a necessary condition in their taking control of municipal franchises that all plant engaged in the business in their bounds shall be expropriated by the corporation and paid for, the value being arrived at either by mutual agreement or by arbitration. One would think from the discussions here that every municipal franchise in sight in Great Britain is operated by municipalities, but such is very far from being the case. I have not been able to procure all statistics, but will give you an example. In England, Scotland, Ireland and Wales, in the year 1895, there were 1318 gas undertakings operated by companies and only 165 managed by municipalities. This, in view of the fact that said municipalities could at any time expropriate these undertakings and operate them on their own account, does not denote the marvellous success our friends would have us believe, the power to expropriate having been in existence for nearly 30 years.

Electric lighting in Great Britain has not until within the last two years made very rapid progress. From all the information I can gather plants installed are a long way from being entirely under the control of municipalities. A good deal of adverse criticism followed the passing of the Electric Lighting Act by the parliament of Great Britain as being likely to retard the progress of the introduction of the supply of electricity there. Reading over the Act makes one think parliament, in their wealth of legislative experience, had in view just such a situation as exists in Canada to-day. The Act is very concise and provides fully for the method in which electric undertakings are to be started. Companies can be organized for this purpose, and on proving their good faith and ability to carry on the business, notice is given to the corporation, which has then a stated time within which to take up the business on municipal account. On their failing or not desiring to do so, what is called a provisional order is then issued by the Board of Trade (in England a department of the government) to the company, permitting them to operate within their district. This provisional order is about equal to our Act of Incorporation and gives a monopoly of the business under proper control. But what about street lighting? Are the municipalities required to pay any price demanded by the company for that service? Most decidedly not. Street lighting is carefully provided for in the Act. The company is compelled on a requisition from the local authorities to erect and supply street lights; the distances apart and other necessary conditions are prescribed in the general Act. Failing an agreement as to the value of the service, arbitration is resorted to for that purpose, the Board of Trade appointing the arbitrators. In fact, arbitration is the key to the whole situation. Every precaution is taken and provision made and no wilful destruction of property is allowed. I do not think I can do better than read to you the sections regulating the transfer from companies to local authorities as set forth in the Electric Lighting Act. It is not very long and will give you a fair idea of the method adopted. Sections 27 and 28 read as follows:—

ELECTRIC LIGHTING ACT.

Sec. 27. Where any undertakers are authorized by a provisional order or special act to supply electricity within any area, any local authority within whose jurisdiction such area or any part thereof is situated may, within six months after the expiration of a period of twenty-one years, or such shorter period as is specified in that behalf in the application for the provisional order or in the special act, from the date of the passing of the act confirming such provisional order, or of such special act, and within six months after the expiration of every subsequent period of seven years, or such shorter period as is specified in that behalf in the application for the provisional order or in the special act, by notice in writing require such undertakers to sell, and thereupon such undertakers shall sell to them their undertaking, or so much of the same as is within such jurisdiction, upon terms of paying the then value of all lands, buildings, works, materials and plant of such undertakers suitable to and used by them for the purposes of their undertaking, within such jurisdiction, such value to be in case of difference determined by arbitration: Provided that the value of such lands, buildings, works, materials and plant shall be deemed to be their fair market value at the time of the purchase, due regard being had to the nature and then condition of such buildings, works, materials and plant, and to the state of repair thereof, and the suitability of the same to the purposes of the undertaking, and, where a part only of the

undertaking is purchased, to any loss occasioned by severance; but without any addition in respect of compulsory purchase or of good will or of any profit which may or might have been or be made from the undertaking, or of any similar considerations. The Board of Trade may determine any other questions which may arise in relation to such purchase, and may fix the date from which such purchase is to take effect, and from and after the date so fixed, or such other date as may be agreed upon between the parties, all lands, buildings, works, materials and plant so purchased as aforesaid shall vest in the local authority which has made the purchase, freed from any debts, mortgages, or similar obligations of such undertakers or attaching to the undertaking, and the powers of such undertakers in relation to the supply of electricity under this act or such provisional order or special act as aforesaid within such area or part thereof as aforesaid shall absolutely cease and determine, and shall vest in local authority aforesaid.

28. Where any matter is by this act, or any license, order, or special act directed to be determined by arbitration, such matter shall, except as otherwise expressly provided, be determined by an engineer or other fit person to be nominated as arbitrator by the Board of Trade, on the application of either party, and the expenses of the arbitration shall be borne and paid as the arbitrator directs.

Any license or provisional order granted under this act shall be deemed to be a special act within the meaning of the Board of Trade Arbitrations, Etc., Act, 1874.

We also have an example on this continent of special legislation for controlling lighting companies. In the Commonwealth of Massachusetts there is a Board of Gas and Electric Light Commissioners appointed by the Governor and Council. This Board has been in existence for about thirteen years. The act establishing the Board sets forth that said Board shall have the general supervision of all corporations engaged in the sale of electric light and gas for lighting and fuel. I have been supplied with copies of the last three annual reports. From these reports it appears that nearly everything connected with lighting companies in Massachusetts, all relations between the companies, their customers and the municipal authorities are dealt with by the Commission. Applications for reduction in price, complaints as to the quality, giving power to increase capital, issue bonds, etc., are passed upon by that Board. What strikes me as very remarkable in dealing with the affairs of lighting companies is the unusual amount of common sense advice given to companies, corporations and customers. Their decisions furnish very interesting reading. The fair and equitable way they deal with all kinds of petitions would come to most of us in the nature of a surprise, our experiences are so different. Here is a quotation illustrating their methods. In giving their decision on a petition from the selectmen of Millbury praying for a reduction in the price and improvement in the quality of electric street lights, the commissioners say: "In reaching a decision the Board found it necessary to consider not only the street lights, but the company's income from its entire lighting business and the way in which its affairs are managed. Those who invest their money in order to render a public service of this character are entitled to a reasonable return from their business when properly conducted, but are not entitled for the sake of such return to impose upon a community additional burdens on account of careless or incompetent management." In this case the selectmen had offered \$2,000 for the service, the company asked \$2,500, and the Board decided that \$2,375 was a fair price.

Every lighting company in the state is required annually to make a return to the Board in a form prescribed by said Board of their financial statement for the year, giving full particulars as to capital, income, expenses, dividends paid, etc. It may interest you, gentlemen, to know that of companies doing a purely electric business in Massachusetts the table of dividends paid furnishes the following information: Report for 1895 gives 59 such companies, 35 of these paid no dividends, 2 paid less than 5 per cent., 22 paid 5 and over. In 1896 there were returns from 63 companies, 33 of these paid no dividends, 6 less than 5 per cent., and 25 paid 5 per cent. and over. In 1897 Report 62 companies are given; 31 paid no dividends, 9 less than 5 per cent., and 22 paid 5 per cent. and over. If this is the condition of electric lighting investments in a wealthy, thickly populated and prosperous manufacturing state like Massachusetts, I feel certain, could reliable statistics be obtained from the Canadian companies, an even worse showing would be made.

I have endeavored as briefly as possible to lay before you samples of legislation provided for the governing and regulating of capital invested in companies similar to those with which most of us are connected. The question that presents itself to my mind is: Have we not a right to claim the attention of the Legislature of Ontario (I mention Ontario because it is the storm centre of the present agitation), and present to them a request to pass legislation to meet the situation. Municipalities having invited citizens to invest their capital, persons who have taken the risk should be furnished with a reasonable and fair amount of protection. As the law at present stands opposition works can be started by corporations, and enterprising citizens taxed to support a concern competing with them and having the whole taxable resources of the ratepayers behind them. One would think that sound economy and common fairness should dictate a change in the present mode of regulating such investments,

The consolidation of the British and Massachusetts laws, would, I think, meet our conditions. I feel certain that a majority of the companies would be only too well pleased to transfer and take 75 per cent. of the money invested in their plant, should it be decided that municipalities desiring the control must first purchase existing plants.

My reason for thinking the Ontario government ought to look favorably upon our request is, that they have already acted upon and recognized the principle of transferring existing plants to municipalities where they wish to assume and manage semi-monopolistic franchise. In the Gas and Water Company's Act where power is given to cities, towns and villages to take possession of and pay for such plants, at present this power is permissive on the part of local authorities. It occurs to me, however, if corporations were compelled to purchase existing plants before going into business the movement would lose a good deal of the spice and zest it now has for agitators. Gentlemen, this is an important question, and I trust this meeting will be the beginning of an organization including every lighting company in Canada that will persevere until legislation is secured to prevent the making of no value the capital invested in good faith in the lighting business. Let us arouse from our lethargy and not lose sight of the fact that our very existence depends entirely upon the exertion of each and every individual interested.

Before passing from the subject permit me to say it is with pleasure I can testify that the leading manufacturers of apparatus in Canada cannot be charged with what I have noticed complained of in the United States. There it is stated that manufacturers of electric lighting machinery, finding the field for disposing of their products getting limited, are now giving their attention and for the sake of making sales, persuading municipalities to go into the business. We do not expect manufacturers will refuse to sell to municipalities when they wish to purchase; that would be unreasonable. But that they take a stand for the best interest of the business and do not lend themselves to helping in confiscating the property of those who had the courage to invest in electric lighting enterprises, is very much to be commended.

I cannot close my remarks without a feeling reference to the untimely death of our respected late 2nd Vice-President, Mr. E. Carl Breithaupt. I am sure I express the opinion of all who had the pleasure of knowing him that he was a young man of great promise in his adopted profession, and a genial and trusty friend. His death is a decided loss to our Association.

In conclusion I can safely affirm we all agree that those of our members who have taken the trouble and time to prepare papers for our meeting are deservedly entitled to our sincere thanks. In no way can we better show our appreciation of their efforts than by attending punctually at the hour of meeting, that they may have the inspiration of our presence. It is theirs by right of courtesy and I feel sure each member will concur in this and fulfil his individual responsibility and duty by punctual and regular attendance.

I desire to express my thanks for the distinguished honor you conferred upon me in electing me to preside over your deliberations at this meeting. I crave your indulgence for any shortcomings on my part.

At the close of his address the president was greeted with applause.

The President: Does the Association wish to take any action at this stage with regard to the recommendation contained in my address.

Mr. J. J. Wright: I would suggest that, as we expect a much larger attendance to-morrow, the matter of appointing a committee to take up this recommendation be allowed to stand until then, and in the meantime the members will have an opportunity to think it over.

Mr. C. B. Hunt: Mr. President, while I agree with Mr. Wright, do you not think it better to have a committee appointed now, so that a report can be made to this convention.

Mr. J. J. Wright: It is not necessary to make a report to this convention.

Mr. Hunt: I think the committee ought to report back to this convention, as we only meet once a year. With your permission I would like to name a committee to take up this matter, consisting of the following gentlemen: Messrs. Wm. Williams, S. Noxon, B. F. Reesor, J. J. Wright, J. Lamont, H. Comstock and the mover; and that this committee report back to the convention to-morrow.

Mr. J. J. Wright: I second the motion.

The president put the motion, and on a vote being taken, declared it carried.

Mr. C. H. Mortimer, secretary-treasurer, read the minutes of the last annual meeting, which on motion were adopted as read.

The secretary then read his report as secretary-treasurer for the past year, as follows:

SECRETARY-TREASURER'S REPORT.

MR. PRESIDENT AND GENTLEMEN:

It is a sincere pleasure to me, as I am sure it will also be to you, that the report which I am now called on to present is one of a very encouraging character.

As regards our membership, there have been added during the year 42 active members and two associates, a total of 44. During the same period 9 active and 5 associate members tendered their resignation; 6 active members were removed from the roll owing to having changed their addresses and the impossibility of learning their whereabouts; 33 active members and 14 associates, after having received due notice, were struck off the roll for non-payment of dues. The total number of names removed from the membership list during the year for the causes mentioned, was 69. In addition death has removed two of our members, the late Mr. E. Carl Breithaupt, who occupied the position of 2nd Vice-President, and Mr. A. W. Congdon. Their loss we deeply deplore. Our membership at this date comprises 154 active members and 19 associates—a total of 154 active members and 19 associates—a total of 173.

As regards the large number of persons struck off the roll for non-payment of fees, I beg to quote as follows from my last report: "There are on the roll a large number of persons who, without having resigned their membership in the Association, have ceased to take an active interest in its affairs, and have likewise failed to pay their membership fees. It should be understood that when a person joins the Association, he thereby becomes a member, not for one year only, but until such time as he formally resigns his membership, and that until his formal resignation is received by the secretary and accepted by the Executive Committee, he continues to be liable for payment of the annual fee. It is perhaps due to lack of a definite understanding on this point that the actual standing of the Association, with regard to its bona fide membership, is at the present time somewhat uncertain. The time has arrived when definite action should be taken to put an end to the present and future uncertainty with regard to this matter."

The Executive Committee several months ago decided that persons in arrears for fees, who had been carried forward on the roll from year to year, should be notified that their names would be struck off on the 1st of April if their dues were not previously paid. This decision was carried into effect. As a result, though there is an apparent decline in our membership as compared with last year, it has improved in quality, and is on a much more satisfactory footing than ever before.

The finances are in an equally gratifying condition. The receipts for the year show an increase of \$448.03 above those of the previous year, while the increase in disbursements was only \$165.86, leaving a net gain of \$282.17.

Meetings of the Executive Committee were held on July 24th, 1896, Feb. 25th and April 12th, 1897.

At the first of these meetings the accounts in connection with the last convention were passed and ordered to be paid, two associate members were elected and the resignations of six members accepted.

At the meeting in February a resolution of condolence with the family of the late Mr. E. Carl Breithaupt was passed and the Secretary instructed to draft and present the same. The Secretary was instructed to notify members in arrears for fees for a longer period than two years that unless the sum of their indebtedness was paid prior to the 1st of April their names would be erased from the membership roll. The Secretary was further instructed to send accounts for fees to members in arrears for the current year, and give notice that draft would be made if the amounts were not paid within 10 days. Mr. Higman, of Ottawa, was elected a member of the Executive Committee, and Mr. Chas. Hunt was elected 2nd Vice-President to fill the vacancy caused by the death of Mr. Breithaupt. The dates were fixed for the present convention and committees appointed to make the necessary arrangements. Three active members were elected, several accounts passed and ordered to be paid.

At the April meeting five persons were elected to active membership; the sum of \$175 was ordered to be placed to the credit of the Banquet Committee.

Following is a detailed statement of the receipts and expenditures:—

RECEIPTS.

Cash in bank June 1st, 1896.....	\$157 21
Cash on hand June 1st, 1896.....	1 50
197 active members' fees at \$3.00.....	591 00
1 active member's fee at \$5.00.....	5 00
29 associate members' fees at \$2.00.....	58 00
Cash for exchange on cheque.....	15
25 copies of report of Sixth Convention sold.....	2 50
Cash from local electrical companies towards entertainment expenses.....	100 00
Refund from Statistical Committee.....	25 00

\$940 36

DISBURSEMENTS.

Expenses of convention at Toronto.....	\$352 47
By cash C. V. Ward's account, Lorne Park.....	\$106 00
" " C. V. Ward toward floral decorations....	10 00
" " Str. Greyhound account.....	26 50
" " J. Ball, music.....	10 00
" " Board of Trade, rent.....	14 00
" " Caretaker, Board of Trade.....	3 00
" " Elevator man, Board of Trade.....	2 00
" " S. Tidy's account.....	1 50
" " Alexander & Cable's account.....	5 00
" " Monetary Times account.....	24 00
" " "Electrical News" account.....	79 25
" " Canadian Photo-Engraving Co.'s account.....	28 09
" " Geo. Angus, stenographer.....	40 00
" " Ribbon and pins for badges.....	2 88
" " Express charges.....	25
	\$352 47
Grant to Secretary.....	75 00
Stationery.....	1 90
"Electrical News" printing.....	23 00
Telegrams.....	1 30
Telephone messages.....	60
Postage.....	62 32
Exchange on drafts and cheques.....	7 95
Cash in bank May 31st, 1897.....	410 57
Cash in hand May 31st, 1897.....	5 25
	\$940 36

The report was adopted as read, on motion of Mr. J. Carroll, seconded by Mr. E. E. Cary.

REPORTS OF COMMITTEES.

Mr. J. J. Wright, on behalf of the Committee on Legislation, reported as follows: It has not been found necessary during the past year to convene the committee; there was no legislation that affected the interests of the members generally, and any little matters which came up in the House of a local character were attended to by those personally interested. There is also another committee for which I imagine I am responsible in a way, and that is the committee to interview the government on the question of meters. Nothing has been done in that connection, especially after the discussion we had on that question at the last convention. We found that the officials of the government were disposed to meet us in every reasonable way and treated us very fairly, and there was no urgent necessity under the circumstances to have an interview with the government. But I think both in the question of legislation and also in regard to the question of government inspection of meters, it would be well to exercise considerable care in selecting a committee, for the coming year bids fair to be an important year in both branches.

The President: The late Mr. Breithaupt was chairman of the Committee on Statistics, and I was next on the list to him, but I have not as yet been able to get possession of the papers from Mr. Breithaupt's executors. I have applied for them, but they have not come to hand.

Mr. J. J. Wright: Do you think, Mr. President, those papers will be available; I understand that Mr. Breithaupt devoted considerable time to that committee before his death, and if those papers can be made available, they will be quite a help to any new committee that may be appointed?

The President: The papers are in existence, because I had quite a large number of them during our campaign in Guelph. I sent them back to Mr. Breithaupt, and I think I will be able to get them.

The President: I will name Mr. B. F. Reesor, Mr. C. B. Hunt, and Mr. A. B. Smith as a committee to name the standing committees.

GENERAL BUSINESS.

Mr. C. B. Hunt: I do not know whether there are many of the members who know of the new order that has been issued in Council in regard to the inspection of meters; it is one of very great importance to most of us, and I think there ought to be some discussion on it, either to-day or to-morrow. The matter is simply this, that the charge for the inspection of meters now is made per lamp instead of per ampere. To those of us who have a 106-volt service or a 110-volt service the rating for inspection is very much increased. I might give

you an example: Take, for instance, a 10 ampere meter that we used to pay 75 cents for, the rating is now \$1.25; on a 15 ampere meter it is increased from \$1.25 to \$1.75; on a 25 ampere meter it is increased from \$1.75 to \$2.25; on a 50 ampere meter it is increased from \$2.25 to \$3.50; on a 100 ampere meter it is increased from \$3.50 to \$5.50, and on a 150 ampere meter it is increased from \$4.25 to \$7.50. If you happen to have three wire meters it will be pretty nearly doubled on that again. I think, therefore, it is necessary to have some discussion on it before we adjourn the convention.

Mr. J. J. Wright: I would move that we make a present to the government of the whole of our plant. (Laughter).

Mr. Hunt: They will have it soon.

The President: You had better bring the matter up to-morrow. As there is nothing else at present under the head of general business, we will call on Mr. John Murphy, of Ottawa, to read his paper entitled "Water Driven Plants."

Mr. Murphy then read his paper, which appears on page 123.

The President: I might say that we have water power some seasons of the year; most seasons we have not. The most satisfactory regulation I find is a quick-acting engine on the same shaft with the water wheel. That has been my experience in regulating when running with water power. The governors that we got did not seem to act quick enough, and the lights were not at all satisfactory, so we put the engine on the same shaft and governed with it.

Mr. H. O. Fisk: Mr. President, we regulate about the same way as you do, although we have one water power generator with an automatic regulator, which works very well; it may lose 10 or 15 volts, perhaps, with a very sudden change of load; it never exceeds that. In our incandescent lighting we regulate it by hand, and just increase the power as the load comes on, and take it off accordingly. It works very well.

Mr. B. F. Reesor: I have had no experience with regard to driving electric plant with a water wheel—we drive ours with an engine, but I have had considerable experience in water wheels, and I can quite understand where a water wheel is taxed to almost its utmost capacity it would vary very much. But the same thing holds good with an engine or water wheel, and much more so with a water wheel; it will pull it down very much in putting on a considerable load. A good plan is to have any amount of power to spare. The throwing on of an ordinary load will not affect a water wheel so much by having a governor, but where the wheel is taxed to almost its capacity I can see the difficulty that no governor will help very much to overcome the pull down for electric incandescent lighting.

Mr. Fisk: In regard to governors for street railway work: I suppose that is about the hardest kind of work we have to deal with. We found down in Peterboro' that it was impossible to get a wheel that would stand governing for any length of time; the pinions and everything wear right out with the constant rocking backwards and forwards. We simply had to abandon it, and I believe for that reason that the apparatus that provides a constant load for a generator would perhaps be the best in the end. We had a couple of wheels revolving on balls, and the balls actually cut right into the iron, so that the thing came right down and ground away there, and would not work. We had no end of trouble till we took our governor off, and I have since thought that perhaps the best way is to keep a constant load on the machine if it is possible. I believe there is an apparatus working up here at the Niagara Falls power house now that keeps a constant load on the generator all the time; when the load is not on the road it is on the resistance.

Mr. S. Noxon: I do not know whether I am presumptuous in offering to say a word, seeing I am not interested in a water power plant, but I have had considerable experience in the use of water power. I lived for a time in Walkerton, and we had a large water

power there which we employed to drive two or three mills. I took considerable interest in the matter of the regulation of water wheels, and came to the conclusion from the experiments made there that it was impossible to regulate a water wheel running at a slow speed, under a comparatively low head. The feed of the water being so sluggish in its action, it was impossible to get any close regulation by any governor; the governor might work quickly but the wheel would not. It wasn't any trouble to get a governor to operate the gate, but the trouble was to get the wheel to respond quickly enough. I have seen governors applied to water wheels under a very high head which regulated very closely, but that is the only condition under which I believe the governor can be applied to a water wheel to give anything like a close regulation. It can be done there because the wheel runs altogether with the impact of the water, and as soon as the water is shut off a little the wheel responds. I think that is about the only condition under which a regulator will work upon a water wheel with any degree of satisfaction.

Mr. A. B. Smith moved, seconded by Mr. A. M. Wickens, that a hearty vote of thanks be tendered Mr. Murphy for his interesting paper. Carried.

The President: I will now call on Mr. Wickens to read his paper entitled "The Steam End of an Electric Plant" (see page 123). It may come in very profitably after having just had the water end.

Mr. Wickens then read his paper.

Mr. J. Milne: There appears to be a little mistake in the second paragraph. If you look at the paper it says: "Our steam engine is only a heat engine, and is subject to many losses, in fact, in some of the old engines with large cylinders and slow piston speeds, the water consumption was as high as 60 lbs. per hour per h.p., while to-day, with our higher boiler pressures and faster piston speeds with early cut-offs, we reduce that to two and one-half pounds water per h.p. per hour."

Mr. Wickens: That is intended to have been 12½ pounds.

Mr. Milne: It says a little further down: "This very high pressure at that time was only expanded eight-fold, and even under such circumstances gave a h.p. for about two pounds of water per hour." I presume that should be "12" again.

Mr. Wickens: Yes.

Mr. J. J. Wright: There must be some discrepancy here, because you are comparing a modern expansive plant with the experiments of Mr. Perkins, which were manifestly not up to date.

Mr. Wickens: With regard to the engine at Sibley College, there have been a great many reports sent out about it; they were using steam at 500 lbs. pressure; it was an experimental engine built to see what they could do. They undoubtedly have been getting a h.p. with 10 lbs. of water. What the evaporation of the boiler was I don't know exactly; they simply gave the result of the use of the steam in the engine; if the evaporation was 10 lbs. of water per lb. of coal, they were getting a h.p. for one pound of coal per hour. There is no question they have got an exceptionally and remarkably cheap running engine. The point is where to stop putting in cylinders to save money. A short time ago a triple expansion engine was built in such a way that the intermediate cylinder could be discarded; this was a Wheelock engine, and upon experiments they found they had just as much economy without the intermediate cylinder as they had with it—that the friction and loss in connection with that intermediate cylinder, under certain conditions of load, counterbalanced the efficiency of it. There were certain loads under which the engine was run in which the cylinder was all right.

Mr. Milne: There appears to be a little exaggeration about the middle of page 6 of the paper, where Mr. Wickens makes the quotation from the paper read before the British Institute of Civil Engineers, as follows: "Thus an expenditure of 5, 10 and 15% of the furnace heat to super-heat gave a net gain of 12, 28 and 70% respectively of the work done for the heat supplied." I would take that to mean that by superheating the steam

up to that temperature you got 70% more work out of the engine.

Mr. Wickens: No; there is simply an increase of seventy per cent. in the thermal efficiency; it is not so much the work done at the engine.

Mr. Milne: I am inclined to think that superheating is not what it is cracked up to be, because in the tests made by superheating there is very little gain in economy shown. In fact, where an engine is properly designed you can scarcely measure the amount gained by steam jacketing. A steam jacket is a good thing on what we might call a poorly-designed engine, but the amount of gain that can be got out of an engine with the cylinders jacketed does not exceed five per cent. at the very outside. This is a big saving in some places where they have large units, but in smaller units the saving would be a minus quantity. Sometimes we think because an engine is steam jacketed and so on, that we are going to get extremely high results in economy, but I think if the tests are properly conducted and everything measured properly that there will be very little saving. In designing engines there is one thing that has to be taken into consideration, and that is to make the difference of temperature between the initial pressure and the final pressure as small as possible so as to prevent condensation; the greater the difference the greater the condensation, and steam jacketing in a case of that kind may help a little, but where you have triple expansion I do not see that steam jacketing is of any use whatever. Of course, in taking in the gain of steam jacketing you have got to take into consideration the amount of steam spent in steam jacketing.

Mr. Wickens: I think what Mr. Milne says only bears out this very idea in my paper. I think he is right as far as he goes with regard to steam jacketed cylinders. We all understand that the affinity that heat has for iron is very great, and one of the strong reasons we are running a high speed engine to-day is because the ends of the cylinder do not get time to cool, and the incoming steam has not got to heat a lot of iron before it does any work. Take a slow speed engine, and when you open a steam valve at one end of the cylinder the first work that the incoming steam does is to re-heat the metal up to the heat it was when the steam was admitted at the previous stroke, and this is the first expense on the steam. This thing must have been recognized by engineers since the commencement, because the whole trend has been to stop it. Now, with regard to super-heating steam, when you get the steam super-heated and get enough heat in the steam so that when you release it, it has lost so little that the iron has nearly the same heat as the incoming steam, you will get over the very loss that they tried to save by steam jacketing these cylinders, provided you can carry the heat through to the end of the stroke. As I said in the paper, some thirty years ago most important experiments were carried on in the United States Navy on the use of super-heated steam; they discarded it because they could not keep the super-heaters tight and could not lubricate. To-day they have got rid of all that trouble; they can both keep the super-heater tight and lubricate the parts of the engine inside with the heat as high as 650 or 670 degrees. The particular things that stopped them in the early times have been overcome; and it seems to me to be a matter of experimenting before we can expect very much reduction in the use of coal by means of super-heating the steam.

Mr. Milne: There are slow-speed engines running to-day without a super-heater showing better results than many of the fast-running engines, so it appears to me there is a discrepancy some way or other.

Mr. Wright: I don't think you save anything in the loss of heat by the rapidity of the action of the engine. No matter how fast the steam is admitted, expanded and exhausted from the cylinder it will make no difference; if the vibrations are very rapid it doesn't give time for the iron to take up the heat. Of course, there will be a general average. It is just exactly as though you have a steam gauge on a cylinder where the pressure is fluctuating—you cannot possibly get at it. The gauge

cannot go fast enough, but if you take and choke that off you get the general average of that heat no matter how fast the engine is running, or whether the engine is running very slowly or very rapidly.

Mr. B. F. Reesor: A little further down in this paper I see Mr. Wickens says, in reference to keeping boilers clean, that some require caustic soda, etc. Nearly all the boiler compound men that come around say in the preparations they have got there is no caustic soda to keep the boiler clean. Then he says, "All organic matter needs alum or fessic." I would like to know how Mr. Wickens administers the "physic." (Laughter.)

Mr. Wickens: That is a misprint; it should be "ferric acid." If you put a compound into a boiler you are simply giving it physic.

Mr. Fisk: What is the objection, if any, to using caustic soda.

Mr. Wickens: I would state, as far as my knowledge of using caustic soda for boilers goes, that the trouble is, it makes the steam so sharp that it cuts the valve faces, and more especially it will injure brass valve seats. A certain portion of it goes off in the steam.

Mr. Fisk: Does it go off in dry steam?

Mr. Wickens: Oh, yes.

Mr. J. J. Wright: There is a simple way of getting over the difficulty, that is, to give the boiler a dose of caustic soda and close it up, when it is not running, and then blow that out. That is the way we use caustic soda in our boilers. We let it stand there in the boiler without using the steam at all, and then wash out the boiler and go ahead.

Mr. C. B. Hunt: How much caustic soda per horse power would you put in, Mr. Wright?

Mr. Wright: We never figure it that way at all. The engineer simply says, this boiler is almighty dirty, and he would put in perhaps ten pounds of caustic soda. We find the same difficulty that Mr. Wickens speaks of if we put in a small quantity of caustic soda. It is, I think, the quickest scale remover that there is. We put in caustic soda in the boiler, and we found eventually the brass seats of the valves would show deterioration and a cutting of the faces, and we laid it down at once to the caustic soda and stopped using it, except in the way I have stated.

Mr. B. F. Reesor: Is there any gentleman here who is using petroleum?

Mr. Wickens: Having spent a few years in boiler inspection, it is a matter that I have had some opportunity of knowing something about. There are places where it is perfectly safe to use crude oil, and where crude oil will stop all scale forming in the boiler. There are other places where it will do to use kerosene and where it will work perfectly well; but any of these things are dangerous to be used generally, because they will not work with some of the chemicals or natural properties that are in the water. As soon as the oil deposits, you get the bottom of your boiler into trouble. I have seen many instances where men have used coal oil or crude oil and thought they had found something that was going to keep them out of trouble, but by the time they were using it five or six months they found they had to put new bottoms in their boilers. Pretty soon the bottom of the boiler gets in such a shape that it begins to leak at the joints and a new bottom has to be put in. There are a few places where it is perfectly safe, where it will not form and go to the bottom with the ingredients that are in the water; in that case it is pretty safe to use oil.

Mr. J. J. Wright: I think those remarks apply more particularly to crude oil. The way to get over that is simply to use refined oil instead of using the crude oil; it is a very good scale remover, putting it in by degrees. There is one precaution that must be taken, and it is a very important one—when the engineer has blown off his boiler and undertakes to put a lantern in to see how clean it is, he is liable to climb the stairs pretty quickly. There have been a number of explosions from that very cause.

Mr. Wickens: There are some of the creek waters that it can be used in, but when we come to using Lake

Ontario or large tributary waters, we usually have trouble with oil in any shape.

Mr. C. B. Hunt: What is your idea as to the cause of the crystallization of the iron plates where sometimes oil and sometimes caustic soda has been used?

Mr. Wickens: I think the crystallization is usually caused from overheating. It can be traced every time to overheating. As I state in my paper, as soon as you heat your iron up to 600 degrees and over, you are beginning to make it take a crystallized form. I am satisfied in my own mind when you get a crystallized boiler it has been overheated.

Mr. Wright: The crystallization may be due to other causes, for instance, the strain on the boiler. By the raising and lowering of the steam pressure perhaps many thousand times a day, a sheet may be changed in shape, as well as by overheating; and also again in the operation of a large number of boilers together, you often find there is a strong and steady vibration in the boilers themselves. By placing your hand against them you feel a very strong vibration that is set up in the construction of the boiler, and is the cause, no doubt, of crystallization. But I should think the main cause—I have always looked at it in that light—was the increase and decrease in the strain of the boilers, changing so slowly as not to be measurable, perhaps, the shape of the plates in the boiler.

Mr. W. Williams: We have tried various compounds in our boilers, and we find coal oil is the best; it is the only thing that will keep our boilers clean. We use Lake Huron water.

Mr. G. Shand: We use a quart a week and pump it in; our boiler is about 100 h.p. We feed it in gradually just before we shut down.

Mr. Yule: So that it doesn't go off in steam.

Mr. Shand: No. We blow it off.

Mr. Hunt: Do you have any foaming from that?

Mr. Shand: No.

Mr. Reesor: Where is your plant located?

Mr. Shand: Sarnia. We do not get a perfectly clean boiler with the coal oil, but we get it clean enough to suit. You can take a scraper and scrape off the loose scale.

Mr. C. B. Hunt: We had a little experience in our railway power house in London. The water we use is taken out of the river, and just above us are the gas works and also several city sewers, so we get "nice clean water." However, more or less of the scum from the gas works, in the shape of tar, etc., comes flowing down with the water, but there was some trouble with it, as Mr. Wickens stated; it formed a small amount of scale. We had to get a cold chisel and go right along and scrape it off. It wasn't as thick as a sheet of paper, but it was sufficient to cause one of the boilers to bulge down.

Mr. Wickens: I have seen the same thing occur with the use of coal oil in boilers.

Mr. Hunt: It is a sort of drainage from the gas works.

Mr. Wickens: I had the same thing occur in Belleville. They got along splendidly for a few months, but then they found a scale on the bottom.

Mr. B. F. Reesor: What would Mr. Wickens recommend for water that contains carbonic acid gas and oxygen that causes the tubes to pit very rapidly?

Mr. Wickens: Any kind of a pulp; take the Eucalyptus leaf, which makes a jelly, or any good kind of gelatine that is heavy enough to stay down. If you break one of those pits you will find there is a little black, wet, slimy centre to it, and if you test it you will find it is acid. There is no question in my mind but that any of those particular jelly-forming plants will answer the purpose. Irish moss will do if it is properly cooked down, but the most efficient I have heard of is the reducing of the Eucalyptus leaf into a jelly.

Mr. Reesor: Do you think the Balm of Gilead gum would do as well as the Eucalyptus?

Mr. Wickens: I don't know; it might. I never saw it tried.

Mr. Noxon: I am connected with an institution that has three large boilers. We are using water from the

river Thames; the water is very strongly impregnated with lime, and we have difficulty with lime scale. We tried all kinds of things, and the only plan we could adopt was to use caustic soda. We would put in a quantity of the soda and heat it up to the boiling point and let the boiler stand two days, and then heat it up again with sufficient pressure to blow it off. In that way we could keep our boilers very clean and without any detriment to the valves or brasswork of the engine.

Mr. Wickens: By using it that way you must use considerable. You have got to make it strong enough to take the scale right down.

Mr. Noxon: You require an extra boiler always.

Mr. Hunt: I have great pleasure in moving a vote of thanks to Mr. Wickens for his interesting paper. It is certainly one which every electric light manager or dealer is interested in. I know I am myself.

Mr. Wright: I second that.

The President put the motion, which was unanimously carried.

The convention then adjourned, to meet at nine o'clock on the following day.

In the evening a visit was made to Buffalo, where an inspection was made of some of the interesting electrical features of that city.

SECOND DAY.

The President called the convention to order at 9.00 o'clock.

A telegram was read from Mr. O. Higman, from Vancouver, regretting his inability to be present, and sending greetings to the Association, and wishing it continued prosperity, stating that he would still take an interest and help forward the work of the Association.

A telegram was also read from Mr. L. B. McFarlane, regretting his inability to be present.

Mr. B. F. Reesor, on behalf of the special committee appointed to name the standing committees, reported as follows:

Committee on Statistics: Messrs. A. B. Smith, A. M. Wickens, and O. Higman.

Committee on Meter Inspection: Messrs. J. J. Wright, Berkeley Powell, and James Milne.

Committee on Legislation: Messrs. John Yule, B. F. Reesor, J. J. Wright, John Farley, W. H. Comstock, C. B. Hunt, S. J. Parker, and F. Pepler.

On motion of Mr. B. F. Reesor, seconded by A. B. Smith, the report of the special committee was adopted.

The President: The next thing will be the report of the special committee on the recommendation contained in the president's address.

Mr. W. H. Comstock: As chairman of the committee appointed by this Association, I beg to report that it was considered absolutely necessary that the Committee on Legislation appointed by this Association for the ensuing year be asked to take this matter up, with power to act in raising money for that purpose. I will put in the resolution of the committee of yesterday.

Mr. F. C. Armstrong moved, seconded by Mr. B. F. Reesor, that the report be adopted by the Association. Carried.

Mr. J. A. Kammerer read his paper entitled "Day Loads for Central Stations, and How to Increase them," (see page 124).

Mr. J. J. Wright: It seems to me that this involves a question that was touched upon by Mr. Murphy in his paper yesterday. As I understand it, the idea involved in this paper is the running of arc, incandescent lighting and power from the same dynamo. Mr. Murphy did not seem to recommend that, and he is a gentleman who has had some experience, and I am going to bring this matter up simply to give the friends of alternating current apparatus, and especially to give the writer of the paper, an opportunity to still further substantiate his claim. I remember when I was a little fellow, and that was some time ago, seeing a conjuror who poured out three different kinds of wine out of one bottle; I thought it was a very wonderful thing at that time, but since then I found out it was a fake bottle—it wasn't exactly genuine. I am very far from saying that in this case the dynamo that will produce

all these things and do it as successfully as the fellow poured out his three different wines from the one bottle, is anything of that nature. It seems to me that those who have had experience in running incandescent lighting from the same generator as the motive power circuits have experienced a considerable amount of difficulty heretofore. If there is anything in the electrical field that is going to give us an opportunity of doing this just as smoothly and slickly as the gentleman I speak of poured out his wine, we ought to know it, as central station men.

Mr. W. H. Browne: Mr. Wright has put forward a problem that requires some consideration. I thought he was going to talk in a "right" manner; I thought he was going to speak from experience. As I understand it, he has two separate services in Toronto, one serving power, for which he requires a separate set of dynamos and a separate set of stations, and another plant for his lighting; and I thought he knew something about the fact that that was not a fake dynamo out of which you could get four or five different kinds of "wine," but as a matter of fact that you could run an incandescent lamp, an arc lamp and a motor from the same dynamo and the same wire; but, as he seems to be uncertain about it, and seems to have forgotten some of the things that have been told him, I will tell him something. I presume it is tolerably well known that we have reconstructed our incandescent station and are now operating five dynamos instead of thirty. We have a direct current power service in Montreal; we have an arc lamp service and an arc lamp station. We also have what we call our incandescent station. We have diminished our arc lamp commercial circuit from 350 or 400 private commercial arc light customers to about 125. We have a direct current power service which we have not diminished in any way, but we are serving customers every day with alternating current power service, and our commercial arc service has been diminished by the replacement of alternating arc lamps, so that we have from the same dynamo, the same boiler, the same engine, and the same building, a service of incandescent light, arc lamps and power. That brings up the question that I think Mr. Kammerer's paper directly refers to—the question of a day load and how to get it. We are serving power upon a meter price system; we are asking our customers to pay us for the current they actually use, and not undertaking to serve a flat rate. We have a flat rate price, however, in the nature of a fixed or minimum charge, by which we expect to be repaid the amount of money we have invested, and we make our prices for say 10 h. p. a certain fixed sum, small, but enough to cover our investment, and we are getting, on that line, nearly as much power service as we can take care of, and not at very low prices either. We are doing this in anticipation of a water power service, and the expectation of having low prices on that account. But at the present time we are keeping up the old motor prices as a basis, and we find the customers perfectly willing to give it. We are serving power from the same wire as the incandescent lights, and we find no difficulty; so that the conjure of this fake bottle has disappeared.

Mr. J. J. Wright: I hope the gentlemen present, Mr. Browne in particular, did not understand me as saying this thing could not be done. I am perfectly well aware you can produce arc lights, incandescent lights and motive power from the same service. But the question in the case of our friend with the bottle is that, although he did it, was it a practical operation? I know you can do all this; Mr. Browne is doing it in Montreal. It can be done. But can it be done as a practical and satisfactory operation? Mr. Murphy says he does not think so. From what experience I have had myself, I question whether it is altogether feasible, and I simply brought the question up, not because I know it cannot be done, but I want some of these gentlemen here who are doing this thing to give some of their experience as to how successful it is when it is done. For instance, you have a load, with these different services on the one dynamo; supposing you have a number of incandescent lights, and at certain times during the day there are not very many of these lights on;

some of the motors take a sudden draught of current and it interferes with the steadiness of the incandescent lighting. In Toronto we have our services on entirely different wires, and I would dearly love to get them all on the same machines. Being on separate circuits, I have not met with the difficulties that I have heard other gentlemen speak of in this matter, and that is the reason why I would like to hear something from those who have tried this, as to its practicability, that is, the steady running of incandescent lighting at the same time that you are making constant draughts on the same dynamo for motor power.

Mr. Murphy: With your permission, Mr. President, I will read the paragraph from my paper to which Mr. Wright refers: "Although one of the chief inducements which manufacturers hold out to intending operators of electrical plants is, that the multiphase system permits both light and power to be obtained from the same generator, yet I hold it is a mistake to attempt to supply power from a lighting circuit except in small units. Incandescent light and power should, I feel certain, never be run from the same water wheel." It is the trouble experienced in the regulation of the speed of the machinery, not of the dynamo itself, to which I refer. I think that is plain from the paragraph.

Mr. Fisk: We are not running power and lighting from the same machine to any great extent, but a few small motors do not seem to make any difference.

Mr. Milne: I do not think there can be any doubt on the subject whatever regarding the supply of light and power from the same circuit; it is unsatisfactory, especially where you have a large amount of power to supply. Take it in Toronto, where we have such a lot of motors and one thing and another requiring heavy powers, and it is impossible, no matter what the machine is like, to have perfect regulation. Take, for instance, the Edison three-wire system, where an electric elevator is turned on taking two or three hundred amperes to start with. I defy any system to have a perfectly steady light when we have a load of that kind, and it will be all the worse, I am certain, when the load is less. The variation during a maximum load is very small, but where you have a very small load the variation is considerable; even in turning on a six to twelve h.p. motor you are sure to notice a wink in the light, whether that is caused by trouble in the generator or engine. Suppose it is in the engine, then the trouble is just going to happen as readily with the multiphase as with a continuous system; if the trouble is in the water wheel, it is going to make itself manifest in the light. I do not think it is very feasible to run the whole thing from the one machine, even though you had a separate circuit for the lights and a separate circuit for the power. As long as they are all driven from the one machine you are going to have the same result, because, if it is in the regulation of the engine, it is going to affect the lights. In Toronto, we are going to considerable expense in taking off all these heavy powers from our light circuit, and putting them on what we call a power circuit; at the same time we have been running on the three wire system for several years with a day load probably of about 1,500 or 1,600 amperes power load, yet it cannot be said to be extremely satisfactory. There are times when the light is unsteady because of the sudden increase and diminution of the loads, no matter how perfect the regulation is at the station and the engine running so that you could not see a variation in the speed with a tachometer. Yet we all know that by a sudden increase in the load there must be a variation in pressure; so, as far as I am concerned, I do not see that the thing is very feasible, no matter what the system is.

Mr. W. H. Browne: Mr. Milne has made a claim, I think, resulting from the fact that he has not had direct personal contact with the use of power on a multiphase current circuit with incandescent lights. He says, from his experience, that the change of loads of six, eight, ten or twelve h.p. make a blink in the light. I presume that many of you here have had theatre circuits on your incandescent lighting system; at least they have in

Toronto, anyway, where they may have four or five hundred lights in the border lights and the drop curtain lights turned on and off quickly. Four or five hundred lights represent a considerable percentage of the load on that particular circuit, and the cutting on and off of those lights affect all the other lights on the circuit. I presume that is your experience; it has been necessary in my experience in New York city to make a theatre circuit and have nothing else on, so that the lights for the theatres would be only affecting one another. You have precisely the same conditions in a motor power load, but you certainly can regulate for it; if your direct current machine does not regulate for it, your multiphase machine has its own regulation. We are turning on and off 40 and 50 incandescent h.p. without affecting our incandescent lighting at all, because by regulation of the machine the variation in the line is controlled. Get enough copper in your line and you can cut on and off 40 or 50 h.p., whether it be motor power or incandescent, and the other people will not know anything about it. The experience I had in theatre circuits taught me that lesson—it is easy to take care of it, and your motor load is no different from your incandescent lighting load. We had so many theatres in New York city that it paid us to make a theatre circuit. In Montreal we have five theatres, and each one of these is on a separate circuit.

Mr. J. J. Wright: It appears not to be so much a question of regulation of the machinery itself. I have not the slightest doubt that a good generator could be got that would regulate within a very small percentage, but the difficulty appears to arise from the drop of potential or loss of pressure locally.

Mr. F. C. Armstrong: In considering this matter in connection with the heading of Mr. Kammerer's paper, there is another point of view that has not been touched upon, and which seems to me is really more material to the smaller central stations who are not at present operating a day load, and the slight difficulties in the operation, and that is the commercial side of it. The main difficulty experienced, I think, in working up a power business in connection with the smaller stations is the difficulty of the high price of motors, under present circumstances at any rate. There is no doubt that the alternating motor in the smaller sizes which would be used up to 20 h.p., with the cost of transformers added, is two, three or four times the cost of direct current motors which can be put in, and which do the work; and I think that difficulty has been found to be a very considerable one. There are in Ontario at present 15 or 20 plants using either two phase, monocyclic or three phase apparatus. In connection with these I can only call to mind at the present moment four or five motors which are in actual operation; some of these plants have been running for a year and a half and two years. One I have in mind has been running just about two years, and there has been only one motor in operation since the start. If the price of motors had been brought down to about what you can buy a direct current motor at, the people would not long buy the direct current motor at the price it is. You can get around that by adding to your investment the capitalization necessary to supply the motors, but I think, considering everything, that is very doubtful commercial policy. In connection with the operating side of the matter, there are one or two points that I would like to touch upon. The difficulty which Mr. Browne spoke of in connection with his theatre circuits, realized from a change in load, would, I think, be experienced even more severely by smaller stations, because I agree with Messrs. Milne and Murphy that the difficulty is mainly a difficulty in the prime mover, especially in the operation of small units. It would seem to me, taking the average small plant, that the stopping or starting of a 10 or 15 h.p. motor would have a considerable effect on a 75 or 100 h.p. engine, and therefore a disastrous effect on the regulation of the lighting. There is another point, and that is, the difference between a direct current and alternating motor, due to the fact that with the alternating motor we have to contend with the idle or wattless currents. I am not

aware of any alternating system in which that difficulty is entirely removed.

Mr. F. Pepler: Would those difficulties be applicable to running an electric railway during the day.

Mr. F. C. Armstrong: In connection with lighting?

Mr. Pepler: Yes.

Mr. Armstrong: They certainly would be. We have had some experience in connection with a certain plant in the matter of operating a day lighting circuit and a railway in connection with one another, and we find that while we can maintain a day circuit, it is practically impossible to do so from the same engine, although the engine is of the heavier size, about 200 h. p., from which we are running the lighting machinery. We have tried both.

Mr. W. H. Browne: Mr. Armstrong has responded to Mr. Pepler about the railroad, and it refreshes my remembrance about a statement he made in the course of his remarks that the difficulty appears to be in the prime mover, by which I infer that the prime mover is insufficient for its work, because if you have a prime mover on which you have a unit of so large a ratio, so large a percentage that the going on and off will affect your prime mover, be it a boiler or water wheel, evidently you have not got your conditions apportioned rightly. Mr. Pepler's question, as I understand it, was, what do you do with a railroad business? As a matter of fact I think we all know that the prime movers—boilers, engines and generators—are adapted for railway service so that the whole load may go off and yet its regulation is effected perfectly, the engine is governed and the dynamo is running at its normal speed. It seems to me it is entirely the question of the adaptation of units to the work they have to do. When we talk about theatre circuits being too large, it is meant that they are the largest proportion of the circuit or dynamo to which they are attached. In regard to small stations, the great difficulty I find with them is that the prime mover—the wheel, the boiler, the engine—is not large enough for the work they have to do. They have added on and added on, and put on more lights, and the consequence is they have got too much business for that particular machine, and if they put on a motor or lighting service which will come on and come off, they have more than they can take care of. They have not regulated their machines the same as they do the railway generator. Mr. Armstrong will tell you that he would furnish a generator for railroad purposes that would take the load, no matter what it was, and regulate it. The other matter is simply a question of adaptation, in getting your unit the right size.

Mr. Armstrong: To my mind Mr. Browne has brought out the difficulty even more clearly. It is perfectly correct that for the conditions of railway service we can offer generators which will give a regulation adapted to that service, and also that under that condition of operation the variation of a steam engine, even with such violent fluctuations of load as having the whole load thrown off instantaneously, will not affect the service. There is this difference in a railway service, that it has a variation of 10, 15 and 20 per cent. or more in line potential, and the voltage of a railway circuit will run from 550 to 500 volts, and the line voltage will vary even more. But Mr. Browne will admit it is quite out of the question to have any such variation in a lighting circuit, and that was the point I was endeavoring to bring out in my reply to Mr. Pepler's question. The variation in the prime mover, which is due to the change of speed primarily, I presume, is too great to keep the dynamo potential steady enough to permit of a satisfactory lighting service. Coming to the other side of Mr. Browne's remarks, while there is no doubt weight in what he says, that the cause of this difficulty which will be found in the operation of small plants by the putting on or off of a motor is due to the disproportion between the size, say of a 20 or 30 h. p. motor and a 75 or 100 h. p. generator, still I do not think he would propose as a remedy you should all put in 300 or 400 h. p. I think really that brings us back to the point brought out by Mr. Wright's bottle; it is quite possible to carry three or four or a dozen different

kinds of wine in a patent bottle, but it may not be the best to keep water.

Mr. Wickens: It seems to me that the mechanical engineer is the man who has got to get over the trouble after all. It has simmered itself down to this—it is actually the prime mover that is making the trouble. One of the difficulties is that we have got a good many points to reach in a convention of this kind. The kind of power that Mr. Wright and Mr. Browne have in view most of the time is not the kind of power that most of the other members are thinking about. You take a small plant, and when you come to make a load you are going to make some regulation with regard to the light. I do not think it makes much difference what system you use. Where the difficulty comes in the most is, for instance, take a small electric railroad where they are running two, three or four cars, and often times the load is all off on that kind of a plant. Now, if they were lighting a few lights here and there, there is no engine under the sun that would regulate close enough to make those lights serviceable at all; that is, if an engine is big enough to make sufficient power to pull four cars up a hill with a load, and loses all of that load excepting, perhaps, 50 ampere on a few lights, there is no engine built that will regulate that satisfactorily. No matter how well your engine regulates you cannot make your machine regulate the engine that is driving it. That is where the discussion has got to now. I think in my own experience, by putting in copper enough, and engine enough, and so forth, the matter can be brought down so that the regulation is very close. Take the stations in the smaller towns that have only a few lights in with their power loads, and those lights will be in cellars and places where it does not make much difference whether they are good or not, and if the lights did vary a little with a station of that kind, there would not be much fault found with it; but in the larger places, in Toronto and Hamilton for instance, where there are a great many lights used in stores and other places all day, that is the place where the main difficulty is. The difficulty is to get a light that is satisfactory if it is running in connection with a power service, and apparently we have got to regulate the engine better to get the light better.

Mr. J. J. Wright: I think the discussion has drifted off from its proper lines altogether. I consider that in a discussion of this kind the engine has got nothing to do with it. In speaking of this day load, and in putting in machines to do everything, whether that can be successfully done is the point; never mind the regulation of the engine.

Mr. B. F. Reesor: I see another trouble looming up. I cannot see why, in a large city like Toronto or Montreal, where the day loads of power and light would be pretty well mixed up, it would not pay them to put in a separate circuit. But what concerns me more, and also a good many others, principally in the smaller places, as a difficulty that would come in the way, is that the day load would be principally power; not very many places, probably very few in proportion, would be light; and in the outlying districts where the transforming units are small, what are you going to do with the drop? The transformers that are used in these smaller places have been in use a number of years, and they feel they cannot afford to throw these away and get nothing for them, and thus incur a great loss; whereas in a large place they can afford to do that. And, as I said, in the larger cities the proportion will be a little more equalized. In the smaller towns the lighting would be very limited, probably for the day only for butcher shops and places like that.

Mr. H. O. Fisk: In speaking of regulation, I would like to ask if any of the members have tried increasing the fly wheel capacity. In putting on a small extra load we found if there was a very heavy fly wheel it would carry that until the engine could recover. I was just wondering if anyone had any experience along that line.

Mr. J. A. Kammerer: Mr. Reesor in his remarks speaks of the transformer losses and their regulation. I distinctly mention in this paper that this is being brought about by the re-construction and re-arrangement

of the separate stations, and is the first essential step to the work. If you put transformers in that cost you money to keep alive at night, they certainly are not a good thing to have. That is why I favor reconstruction.

Mr. Farley : I am not very familiar with these questions, but I agree with the proposition that has been laid down here that there must be economy in generating electricity for all these services over the same lines and from the same dynamo. It would seem as if we had not yet arrived at that state where electricians all agree that it can be practically carried out, but for a small company such as I represent it is of very great importance. Where there are railway, power, arc and incandescent services it is like four stations, as it is now ; and then there are the municipalities to deal with. There is the question of the increase of lines, which is an objection to municipalities, and which I understand would be done away with if all these could be done over the same lines without additional poles. In St. Thomas we have three or four miles of poles in some instances, and I am not able to gather whether this can be successfully worked out or not. But, as this is my first visit to the convention, I am very pleased with the intelligent discussion on these questions, and I believe that these Association meetings will result in a great deal of good, not so much to the larger cities as to the smaller places who have to struggle to live. I believe that as years roll by and these meetings continue to take place, and as the intelligence of electricians is brought into contact in this way, we will solve some of these questions that have been raised here to-day. I do not agree with the idea that the engine has not something to do with the question. I think it has a great deal to do with the question ; and yet it does not settle the question that the dynamo, generator, lines and everything else have not to do with it. I shall be glad to attend the meeting next year and see if this question is solved. I must congratulate you, Mr. President, on your office. I am glad to find that you have been elected president of this Association. I hope that you will continue to be an officer of the Association.

Mr. F. C. Armstrong : Mr. Farley seems to have misunderstood the position which I took, as one of those who has not looked upon Mr. Kammerer's solution as the actual solution of the day-load problem. I think there is no person who will question the perfect feasibility and desirability of operating especially a small lighting station and supplying three or four kinds of service from one generator, one circuit, and one set of appliances all through. There are so many desirable things about such a circuit that it is not necessary to enlarge upon them at all. But the question simply resolves itself into one, that in commercial practice it is not found to be, so far as my experience goes, the easiest to work out under ordinary circumstances. As to the feasibility of doing it, any one of at least half a dozen manufacturers of electrical machinery have upon the market multiphase alternating machinery from which they can guarantee a perfectly satisfactory service for incandescent lighting, for supplying motor power and arc lighting.

Mr. J. J. Wright : I don't think anyone will dispute the desirability of this. I think I realize that almost as much or more than anybody here. If the whole of our output could be turned out from one plant it would make a difference in our income. I will give you one instance ; it was caused by our trouble with the late fire. I actually had 2,000 h.p. of engines and 2,000 h.p. of dynamos all in position to operate, and I could not run even a measly dough mixer in one end of the city.

Mr. W. H. Browne : I have inflicted myself several times upon the members here, but I think I will offer one suggestion for consideration that may possibly help us out. In answer to the gentleman from St. Thomas, the cost of operating a central station probably rests entirely in the amount of money invested in the plant and the interest to be obtained for that investment as the first item ; the next item would be the labor of having that plant in readiness to serve light or power ; the third item of expense would be the actual coal, oil

and other material used in delivering light and power. We have two items all the time fixed—the interest upon the capital invested and the labor necessary to produce ; so it may be ascertained by any one who has plant how much it will cost him to be ready to serve light or power. The additional cost that he will have will be the amount of coal, oil and waste that he will use up every hour that he is operating his station. When you come to put a day load on there, you do not increase the capital invested if you use the same boilers, the same engines, the same dynamos and the same wire. The capital invested remains the same. You do not increase your labor item, but you may increase your coal burning under your boiler to produce power. Therefore it is easily calculable what your day service is going to cost you and what you can get for it. And the benefit of that day service is that you reduce the proportion of your capital investment and your labor account pro rata through the hours of service that you get power for ; that is why power service or day service will pay the station no matter how large or how small it is, because you are getting something in return for capital invested and for the labor that you necessarily employ.

The President : Mr. Browne, at what would you place the day load for 7,000 light capacity in a small town ? How much would it be ?

Mr. W. H. Browne : Of course, Mr. President, that will depend entirely upon the size of the units that you use.

The President : Take a place of about 10,000 inhabitants.

Mr. W. H. Browne : Taking old transformers and old methods it would mean a great deal, but taking it by what we do to-day—what we know we can do to-day—the transformer leakage for a 7,000 light plant should not be over 10 h.p., but with the old process it would be 150 h.p.

The President : If you have to run 30 or 40 h.p. for the sake of supplying 25 lights you would be very much out of pocket.

Mr. Browne : You should not cultivate the idea that you want to continue to operate a plant that is using up leakage load in that fashion ; you cannot afford to do it. No matter how small or how large your plant is, you cannot afford to go on using transformers which are using up that amount of energy. It is being proved every day in small plants that they can afford to throw them all away and get transformers that anybody will make to-day for them. All of us will make them a good transformer that will reduce the leakage so that they can afford to run all day long.

Mr. W. Williams : There is one thing that Mr. Browne neglected to mention ; he did not mention the cost of another engineer. You could not expect a night engineer to run all day.

Mr. Browne : I suppose Mr. Williams means that an engineer might cost him \$2 a day. I presume that the power that you would get would bring you in considerably more than \$2 a day. As I understand the day load, it is not your big power, it is not your railroad power, it is one h.p. here, two there and five somewhere else.

Mr. Farley : Supposing you had only that number, three or four ?

Mr. Browne : You could not, perhaps, afford to do it. I have in my mind the case of a comparatively small town where they have a water wheel plant, and when I spoke to the manager of that plant originally about getting in power service, he said : " Well, I don't see any reason why I should ; I would have to have another man on in the day time, and I don't believe I would get any, anyway." That was about two years ago. To-day that man has got in small powers, none of them larger than 10 h.p., and he is getting \$75 a horse power for it out of a water wheel plant. He can afford very easily to pay for his two dollars a day engineer.

Mr. J. J. Wright : I wonder if that is in Paradise. (Laughter). There is one phase of the subject that has been overlooked, and that is the overlapping of the

loads on railway and night work. It may be all right to get a number of motors, but in getting those motors and running them during the day for a certain amount of profit you may paralyze your means of overlapping; that may just knock out the whole of your calculations. You would then have to put in a reserve plant for your power instead of utilizing the same plant that has been put in.

Mr. B. F. Reesor: I would move a hearty vote of thanks to Mr. Kammerer for his able paper.

Mr. F. C. Armstrong: I would second that motion.

The President put the motion, which on a vote being taken was carried.

The President then tendered Mr. Kammerer the thanks of the Association for his valuable paper, which had evoked such an interesting and profitable discussion.

The President: Mr. Wilfred Phillips, who has been so extremely kind to us all, would like the members to go up at noon and take a look at his power house.

NEXT PLACE OF MEETING.

The President: The place at which the Association shall hold their convention in 1898 will now be taken up.

Mr. W. H. Browne: There is no place on the continent to-day, or rather there will not be next year, that will be so interesting from an electrical standpoint as the city of Montreal. There are being installed there two water power plants, that of the Lachine Hydraulic Company and the Chambly Manufacturing Company, and during next year both of these powers will be in active operation delivering current in the city of Montreal. They will both be characteristic in their own line—one will be characteristic for its vertical turbines and three-phase apparatus, made by the Canadian General Electric Company, and the other will be characteristic for its horizontal wheels operated under a high head and on the induction system of machinery; one will be operating at four or five thousand volts, the other at twelve thousand volts; and the power houses, dynamos and transmission lines will be all entirely new and characteristic. I certainly know of no place that can interest electric light people so much as the opportunity of seeing both of these in operation at the same time. From this standpoint and on behalf of the Royal Electric Company, I extend to the members a hearty invitation to come and see our power houses, and I am sure the Lachine and Chambly people will be very glad to have you all come and see theirs.

Mr. Thompson: Mr. Browne overlooked the mechanical engineer. He might have told you also, since he came from Montreal, that the street railway company are starting up a large 4,000 h.p. engine, and that will be in full blast next year. We have also several small stations such as we have been discussing, and there are two suburban railway stations, and I am sure that there is no place in Canada to-day where there is so much interesting information to be obtained, both mechanically and electrically, as there is in the city of Montreal. I have been down there over six years, and during the whole of that time between the universities, the small plants and the large plants, I have gathered up, I hope, a lot of very useful information. I am quite sure that if the gentlemen of this convention decide to come to Montreal, you will not only receive a lot of valuable information, but royal treatment.

Mr. Wickens: There is one thing in connection with going to Montreal: About ninety per cent. of our members live in Western Ontario, and while there is no question it would be very pleasant to go to Montreal, we will not get as large an attendance going that far east as we would if we held the convention in a more central place. People cannot spend the time; of course that is their loss. If we go to Montreal we are going to lose something. I feel satisfied we would not get as large an attendance there. We already know what kind of treatment they would give us; we have been there before. There is no place in the world where an association will be better treated than in Montreal, but I feel sure we would not get as large an attendance by going so far east as if we held the Association meeting in some of the more central places up through Ontario. We

have only nine or ten members outside of Ontario altogether; Montreal and Ottawa have a few, but the great bulk are in Ontario.

Mr. J. J. Wright: The best reply to that is the number of members we had at the Montreal convention. I think it was one of the largest conventions we have ever had, and I think some reduction could be got on the railway.

Mr. J. A. Kammerer: Getting on, say, at 2 o'clock you are in Montreal the next evening at six. The fare down by boat and back by rail is only \$12, including berth, and meals going down.

Mr. F. C. Armstrong: The selection of the place of meeting is particularly a matter which affects the central stations, and one which I feel some hesitancy in saying anything about. We people who are connected with companies do not pay our own expenses, and it does not make much difference to us where the meeting is. It seems to me that while Mr. Wright is correct in pointing out the large attendance at Montreal, this year's attendance is somewhat different in character from any former meeting of the Association, and in view of the important work that has been undertaken it is desirable to continue this attendance. I refer to the central station men, and I think the next place of meeting should be one which would best meet their convenience. From Mr. Wicken's remarks it seems open to doubt as to whether it is advisable to go away as far as Montreal; it would involve really a considerable expenditure for our members that care to go and especially those who take their wives with them, and it might tend to materially reduce the size of the attendance of central station men.

Mr. W. H. Browne: Perhaps the reason you have so many members in the west is because you have not cultivated the stations in the east; perhaps if you had your next place of meeting at Montreal you might add to your membership considerably by central station men from the eastern end of Canada. I suggest Montreal because I believe that it is the only place where really valuable instruction in what is going to be the future of this electric lighting business can be obtained. It had not occurred to me that it was a question of time; it had not occurred to me it was a question of distance or expense. And the gentleman who has just made a suggestion, I am thankful to him for it, because he said, you have not got very many eastern people here. Probably they found it too expensive to come west, therefore that might be a way of getting those interested in your Association.

Mr. Wickens: That is the way matters lie; we feel that the eastern men will not come up to see us; we hardly ever get any members from the east. The western man puts up his money and goes down east and sees what is to be seen there, and the eastern man stays there; he never comes up to see us.

Mr. John Murphy: The prevailing impression in eastern Ontario is that the Canadian Electrical Association is becoming an Ontario Electrical Association, particularly a western association. If the meeting were held in Montreal it would knock out that idea altogether, and undoubtedly bring in a great many people from the east.

The President: We held a meeting at Montreal, and we found there were not a great many Montreal people followed us up here.

Mr. J. Farley: We must not overlook the fact that we would not learn a great deal if we went to Montreal and saw all those immense power houses such as we saw last night at Buffalo; they are very often like the falls, magnificent to look upon, but for practical information perhaps you would find it more profitable to come to St. Thomas, Lindsay, or some such place. There is no place in the country that we are all more interested in than the great metropolis of Montreal. We all desire to go there, perhaps, more or less; we can go there during a later part of the season; there will be a lot of excursions, but if we want to get the practical side of this question, while we want to give it a national or Canadian character, any of the smaller places might be better than a large place, and it might

nduce more to go. I had Montreal in my mind until I began to think the matter over, and I believe Ottawa would be a better place for the practical working of electricity than Montreal.

Mr. W. Thompson: I might point out the fact that four years ago when you held your convention in Montreal, there was practically then only one company in operation, that was the Royal Electric Company. During the past four years there have been wonderful changes taking place. The Royal Company has reconstructed its station. I have had the pleasure of going through part of that station, and it is really worth seeing. Then they are at the present time constructing the Lachine Rapid Hydraulic works; there are two new suburban stations both re-constructed since that time; outside of that there are quite a lot of small plants throughout the city and suburbs. I venture to say there is not one-fiftieth portion of the actual operating engineers outside of station managers of the city of Montreal that are members of the Association. Why, I myself was not a member of the Association; I don't know that I am yet, I just handed my application in today.

Mr. Mortimer: Yes, you are.

Mr. Thompson: If I had known five years ago that these conventions were as interesting and as valuable as they are, I would have been a member long ago. The question of expense certainly is a serious one. I have had to bear my own expenses coming here, and I consider I have got two dollars for every one I have invested, and up to the present moment I have only been here since seven o'clock last night. We want amongst our engineers intelligence, and no single man in this country has got a claim on all the intelligence that is going. It is only by an interchange of ideas and an examination of the practical work that we are to get it. I do not want to urge upon the members to go to Montreal personally, because I would rather come to Ontario, for then I get a holiday, but I really think for the benefit of the Association, and knowing as I do the practical experience you can gain, I cannot impress upon the members of this Association too strongly that they should come and see for themselves.

Mr. J. Milne: I think the best thing we can do is to decide on Montreal. I would make a motion to that effect.

Mr. J. Murphy: I have much pleasure in seconding Mr. Milne's motion.

Mr. Pepler: May I be allowed to put in a good word for the town of Barrie. With reference to the city of Montreal, I quite agree with what has been said. But if it is the feeling of the meeting to have the next meeting at some central point in Ontario, I do not think, excepting Toronto, a more central place can be found than the town of Barrie. So far as beauty of scenery and a social time is concerned, I do not think it could be beaten. We have a lovely bay there, on which there are boats running out into the larger lake. The manager of our company owns one of the boats, which I am sure he would be pleased to place at the disposal of the Association, on which the members could go to many points of interest, including Orillia and other places around the lake. Although we would not have anything electrically to offer like Montreal, yet for practical convenience and for a pretty spot and a happy time I do not think you could find a better spot than the town of Barrie.

Mr. S. Noxon: The matter of location for the next place of meeting should not go by default in this way. I make no particular claim, but while I was sitting here it struck me what was the matter with the town of Peterborough for the next annual meeting. Representatives from that city, for some reason, are exceedingly modest in not putting forth the claims of Peterborough. Although I am not opposed to Montreal, at the same time it is my impression that by meeting farther west we would get a far larger representation of those who take an active interest in central station business, that is, the central station managers; yet, at the same time, I would have no objection, providing I feel the same interest in the Association next year that I do now, in going to Montreal, for I think I would be amply repaid. It might also be said that we are all familiar with the generation of elec-

tricity in English, and we might go down there and see others do it in French.

Mr. Armstrong: Mr. Noxon has expressed his surprise at the modesty of the people who are connected with Peterborough. As far as Peterborough is concerned, it is a small place, and we have the modesty to believe that most of the electrical interest there would be connected with our own manufactory, and it would look too much like self-interest to urge going to Peterborough. A meeting at Montreal will give the members an opportunity of gaining a great deal of information as to construction, and of seeing a great deal of up-to-date apparatus and methods.

Mr. H. O. Fisk: We have built a new station in Peterborough, and at the present time we have not anything we would care for the Association to see. In another year we may be in a better position. It is a nice point for pleasure, but I take it we should not consider pleasure the first thing. I would be in favor of going to Montreal, because I believe there is so much there for small people like myself to learn. I consider it is like buying a book; if you only get one point out of it that is of value you have not lost anything, and perhaps you have gained a good deal. That is one reason I would be inclined to very strongly favor Montreal.

Mr. W. Williams: What is the matter with Sarnia, and there is London and Guelph?

The President: It has been moved by Mr. Milne, seconded by Mr. Murphy, that the next meeting of this Association be held in Montreal. Carried.

The President then called upon Mr. William Thompson, of Montreal, to read his paper entitled "Determination of the Heating Power and Steam Producing Value of Coals from a Preliminary Examination." (See page 119.)

Mr. Thompson: Probably, Mr. President, with your permission and the permission of the members, it may be desirable, before there is any discussion, for me to make a brief synopsis of the object in writing this paper. I know that it is a somewhat difficult question to tackle, but I think that those of you who have followed up steam engineering as closely as I know members of this Association have, will agree with me that our present methods of determining the efficiency of our boilers and our furnaces is somewhat crude. Now, let us look at it in this way: Supposing we are able to determine (which we are quite able to do with very little practice) the exact heat producing value of the coal which we are using. We will carry that over, speaking commercially, to the debit side. We want to be in a position to trace that heat. We, as engineers, get the quantity of water that we have evaporated and made into steam, and we call that efficiency, but it does not give us the information that we actually require. We want to know, if there is a loss, where that loss occurs. Let us trace it out in this way: We start by knowing the maximum quantity of heat that the coal will give; we then collect a sample of our fuel gases and ascertain the composition of them, and from that composition we are enabled to know the exact quantity of air that has been admitted to the furnaces. We are then enabled to determine the exact quantity of carbonic oxide that has been formed during combustion, and if we take and examine our ash and still continue our analysis we are enabled to determine the exact quantity of combustible matter that still remains in the ash, because none of our furnace or grate bars are perfect enough to give nothing but pure ash. We have first the composition of the gases, we have then the quantity of air admitted, we have the heat lost through the formation of carbonic oxide, or heat lost through imperfect combustion. We have measured our water or weighed it, or ascertained the exact quantity of water fed to the boiler; we have determined the moisture in our steam. We know exactly, then, what amount of heat has passed into that water or what amount of that heat has been efficient, and we can take it as being fairly reasonable that the balance of the heat, if any remains, has been lost by radiation. There we have a complete chain of events, a complete trace of the whole of our process from beginning to end, and we know just exactly where a loss exists. This may pos-

sibly give the gentlemen present a clue towards discussion, and I shall be very glad to hear from the engineers or any one interested who wishes information.

Mr. J. Milne : The determination of the heat value in coal is generally done by three methods, first, chemical analysis ; second, by combustion in a coal calorimeter ; and third, by actual burning under the boiler. There is some doubt as to the correctness of chemical analysis. The coal calorimeter is certainly, I think, the most correct method of arriving at it, but if the two experiments are properly conducted—the chemical analysis and the combustion in the coal calorimeter—the results do not vary very much ; but at the same time, when you test a sample of coal, or take a variety of samples from the coal pile and mix them all up and burn them in the coal calorimeter, that does not say the coal heat we are going to get for that day is of the same quality, because you all know, although you are getting coal from the same mine, that you will get good and bad cars of coal. I do not see, even if we determine the exact value of the heating properties of that sample or set of samples, that it is going to be of very much value to us. The thing is this : We can roughly approximate the heating value of coal, and I don't think that we can be very far out if we assume that as being very nearly correct, without going into any analysis or calorimetric tests. There is an instrument—probably my friend Mr. Thompson is acquainted with it ; it is invented by a Mr. Thompson and is used by the North British and some of the leading lines in the Old Country—which I think it might be advisable to describe. It gives you the heating value of coal at once, almost without any calculation. You take a gramme or two grammes of coal ; after you have powdered it up, put it in a vessel and put in a certain amount of oxygen, you immerse this little combustion chamber in 966 grammes of water, or double that quantity if you are using two grammes of coal, and if that amount of water is raised one degree Fahrenheit, then that would indicate that we have one pound of water evaporated or boiled off into steam for the raising of the water 1° Fah. If you raise that 10 degrees, it is equivalent to 10 lbs. of water boiled off. If you want to find the thermal value of the coal you are testing you would simply take your 1,934 grammes—that is the amount of water—multiply that by the rise in temperature, and divide by the number of grammes of coal you are burning ; that would give you the exact heat value in the coal. I think that is the simplest method we have got, and it is just as accurate and near enough for all practical purposes, and from that you can easily determine roughly what the efficiency of your boiler would be.

Mr. Thompson : The use of the calorimeter is not such a simple matter as it appears. I am very well acquainted with this instrument in question, and I consider the information you get from it is entirely astray. We want to get the exact amount of heat, and you must understand we are dealing with a very small quantity of fuel. A certain quantity of that heat only is given to the water ; the metal itself absorbs a certain quantity of heat, and there is a certain quantity, no matter how carefully you conduct your examination, lost by radiation. The calorimeter constructed on the principles which are mentioned does not give the exact power of heat in coals, and it takes a very delicate manipulation to first ascertain the amount of heat that is passed into the water and the amount required to raise that metal receiver up to a certain temperature, and then the amount of heat that is passed off by radiation. Moreover, to the engineer this is not the information that he really requires, because there may be a great difference between the actual heating power of a coal and the industrial heating power of a coal. While we can test the industrial heat value of a fuel very nicely when we know exactly the condition under which that coal is being consumed, you cannot do that under a boiler, because the conditions exist and you know nothing about them ; you have simply to guess at them. Therefore, if we want to know more about the actual heat value of coal, we want, as engineers, before we can trace discrepancies in our plant, to be able to get at

the steam producing value, which varies according to the composition of the fuel, as I have said.

Mr. J. Milne : I am still of the opinion that the coal we buy must be judged by its heating qualities ; there is no doubt about that. If we buy one lot of coal at \$5 per ton, and get 14,000 thermal units per ton out of it, and for another lot pay \$2.50 a ton, and only get the half of that heat out of it, it is just as cheap to buy the dear coal as the cheap. What we want to arrive at as engineers is a simple method of determining the amount of heat, and the simpler the method is the more accurate will be the results. It cannot be gainsaid that that instrument by Lewis Thompson is perhaps used by the largest concerns in the world for determining the heat value of coal ; in fact, it is called for in the specification that the coal must be tested by it, so that there must be some good point about the instrument.

Mr. Thompson : I did not mean to say that the instrument was useless, but with the average information engineers have they are not enabled to use a calorimeter. Take our large Montreal plants as an example. I heard it said that during last year the Royal Electric Company saved some 6,000 tons of coal, and the Street Railway Company saved a large amount. Now, wouldn't it pay large concerns like those, where they are turning over thousands of dollars' worth of coal every year, to give their engineer the apparatus whereby he could intelligently determine the value of the fuel, and also determine how to use that fuel? The use of a calorimeter is a delicate operation, and is liable, even with the Thompson calorimeter, to give a great deal of error. The making of a proximate analysis of fuel fortunately is a very small matter. My method has always been this: I take a large quantity of coal and grind it up, and so intermix it that I get as nearly an average sample as possible ; then I go to the other side of the pile and make from 15 to 25 analyses and get as nearly as possible a fair average analysis of the coal in question, and it is surprising how these analyses will vary. No intelligent engineer would go and take the best coal he could see. If he did it would not be fair to himself or his employer ; he would make an effort to get as nearly as possible an actual sample, then the making, as I said before, of the proximate analysis becomes an easy matter. In cities where they can get almost anything they want from the wholesale chemist at greatly reduced rates the cost of an apparatus of this kind for the engineer soon becomes very little. They are more liable to get correct results from a chemical analysis than the average engineer is from the use of a Thompson calorimeter.

Mr. Wickens : When you are going into calorific tests it requires considerable ability and some apparatus. That is all right for a large plant. The larger plants, where they are turning over a good many thousand dollars' worth of coal in a year, can afford to pay for them, or they can send a sample of their coal to the neighboring college. To the ordinary engineer who is not an expert it takes a long while and a great deal of study to become expert, and you cannot run through the tests Mr. Milne or Mr. Thompson speaks of without being considerable of an expert—not only an expert in manipulating and understanding considerable about gases, etc., but you must be something of an expert at figures. Outside of a few corporations this thing is not of very much use to the ordinary engineer. While there is no doubt that the paper in its points is exceptionally well taken, it is not a thing that can be reached by a great many people. A firm that is burning two or three thousand dollars' worth of coal a year scarcely pays enough money to employ an engineer that has got that much ability ; they get better situations. The question in his case is, what are you going to do about combustion? He will go at it in a kind of thumb-handed way ; he weighs both water and coal, and eventually tells you he is getting so much evaporation for so many pounds of coal. He may not be exactly right, but I think he is very often as near right as the one who is going to figure up a small gramme of coal that represents some thousands of tons and tells us it is so and so. I think the man who goes at it on the other plan will be reason-

ably near; he will not be near enough to say it is absolutely dead right. I do not think there is an expert in one of our colleges that will tell us that he is absolutely correct; when he goes right down to the bottom of it he finds he has got to allow heat for this and that, and it is partly guess work. I feel that in that particular line, for weighing coal and water and taking the temperature of your slack gases, the whole thing can be done with a pair of scales, a thermometer, a little brains and carefulness, without very much elaboration. After burning a ton of coal you can tell whether a car-load, ten car-loads or a vessel load is going to be worth what is paid for it. I think for the ordinary engineer we have not the class of men that can reach to the height of knowledge that Mr. Thompson and Mr. Milne have attained to. I have found, from travelling around among the engineers throughout the country, that it takes a considerable amount of hard study to attain that particular knowledge, and we have not the means among our ordinary engineers for carrying out such an elaborate scheme. For the purpose of the ordinary engineer, or the engineer running a small plant, his own test is just as satisfactory to his employer as one that will be more elaborate.

Mr. J. J. Wright: It is nice to be able to determine the exact value of a sample of coal, but before that can be of value to the large coal user it will be necessary for Mr. Thompson or some other gentleman to concoct a scheme to compel the mining companies to send in the same kind of coal that we get in the sample. I have great pleasure in proposing a vote of thanks to Mr. Thompson.

Mr. Milne: The sample is really taken from the coal pile, and we have got the stuff there.

Mr. Wickens: I have much pleasure in seconding the vote of thanks to Mr. Thompson.

The President put the motion, which was carried unanimously. The convention then adjourned, to meet at 2 p.m.

During the noon recess a visit of inspection was made to the well equipped and arranged water power station of the Niagara Falls Park and River Railway above the cataract.

ELECTION OF OFFICERS.

The President called the convention to order at 2 o'clock, and stated that the first thing on the programme for the afternoon was the election of officers, and that nominations for President were in order.

Mr. B. F. Reesor: I would move that Mr. John Yule, our present President, be re-elected for the year 1897-98.

Mr. Dunstan: I have pleasure in seconding that motion. In view of the work that is before the Association during the year, I think it is very desirable that the affairs of the Association should be conducted by the same person who has inaugurated the work now in hand.

Mr. John Yule was declared elected President for 1897-98 by acclamation.

Mr. John Yule: I certainly am very much obliged to you for your confidence. I would rather retire and allow some other person to take the office, and I would give them all the assistance I could. I do not believe in one man holding the office for more than one year. There are a number of gentlemen here who ought to be ambitious enough to occupy the position, and who are more able to occupy it than I am. However, since it seems to be the wish of the entire Association, I accept the position and will do the best I can. I must return my thanks to the gentlemen who have attended here. The surroundings, of course, have had something to do with it, but since we have got you here we are able to show you what a benefit it is to attend these meetings, and when you go home and meet your neighbors, and friends I hope you will induce them to come along with you to the next convention at Montreal. I might also say that we are very much indebted to the gentlemen who have stood by the Association during all these years. It was a struggle to get it along for a time, and now when it is getting on a sure foundation I think we are especially indebted to you; I do not mean myself, I mean the others who have stayed with the Association. There is now a bright prospect of usefulness before the Association, and I would again ask the gentlemen who have come here and have seen the benefits and privileges of being a member to induce their friends and point out to them the advantages to be derived from this organization. I am now open for nominations for the office of First Vice-President.

Mr. A. B. Smith: I would propose the name of Mr. L. B. McFarlane.

Mr. J. Carroll: When leaving Montreal I was authorized by Mr. McFarlane to state that he would not allow his name to go before the Association as being eligible for election, and furthermore, if elected, he would not serve.

Mr. J. Yule: Perhaps Mr. McFarlane wasn't aware that the convention was going to Montreal next year.

Mr. J. Carroll: He told me positively not to allow his name to go before the convention. He stated that he had also communicated with Mr. Dunstan, and that he absolutely refused to serve, and if elected he would withdraw.

Mr. Dunstan: Mr. McFarlane has his hands very full of business at the present time. Personally, I would like very much to see him, and I am sure the whole Association would like to see him elected First Vice-President. The work of that position is not so great; it is not like the work which falls upon the president, and as the Association meets next year in Montreal it seems to me that we might elect him, and if he finds it is utterly impossible to accept the position (it would only be from pressure of work, not from any lack of interest in the Association—he would like that clearly understood), someone could then be elected to take the office. We could wire him and find out if he would accept the position.

Mr. Carroll: I think, judging from his remarks when I left Montreal, it would be a very great mistake to elect him. He

cannot attend the meetings, and feels he should retire. I would propose the name of Mr. C. B. Hunt for the office of First Vice-President.

Mr. J. Farley: Although I think we should endeavor to have one of our vice-presidents in Montreal, if possible, for the present year, I have much pleasure in seconding Mr. Carroll's nomination of Mr. C. B. Hunt.

There being no other nominations for the office of First Vice-President, Mr. C. B. Hunt, of London, was declared elected to the office.

Mr. C. B. Hunt: I am very much obliged to you for this token of your confidence, and I hope it will not be misplaced; with our President, I think we will get along very well.

Mr. F. C. Armstrong: I would move that Mr. J. A. Kammerer be Second Vice-President.

Mr. C. B. Hunt: I have pleasure in seconding the motion.

No other nominations for the office of Second Vice-President being received, Mr. J. A. Kammerer was declared elected to the office.

Mr. J. A. Kammerer: Thank you, gentlemen; I will try and assist our president to the best of my ability, and endeavor to make the convention a success.

Mr. C. B. Hunt: I would move that Mr. Mortimer be our Secretary-Treasurer.

There being no other nominations for the office of Secretary-Treasurer, Mr. C. H. Mortimer was declared elected to the office.

Mr. C. H. Mortimer: I have to thank you very kindly again, gentlemen, for the sixth or seventh time, for this expression of your appreciation.

The President: The next item on the programme is the election of five members of the existing Executive Committee to serve for another year. I will appoint Mr. E. E. Cary and Mr. W. Thompson as scrutineers.

Mr. A. B. Smith: While the vote is being taken I would like to move that the usual allowance be given to the secretary for the expenses of his office.

Mr. Dunstan: I second that.

The President: It has been moved by Mr. Smith, seconded by Mr. Dunstan, that the usual sum of \$75 be voted to Mr. C. H. Mortimer for his services during the past year. Carried.

After the ballots were counted the President said: I am sorry, for the sake of the time it takes up, to announce that the scrutineers have reported that there is a tie, and that we will have to have another ballot for one member in connection with the re-election of five members of the Executive. The four elected are: Messrs. J. J. Wright, F. C. Armstrong, John Carroll and A. B. Smith.

On a vote being again taken the President declared Mr. O. Higman, of Ottawa, elected as the fifth member.

The President: I am now open for nominations for the election of five new members to the Executive.

Mr. W. H. Browne: I understand there is a gentleman present who comes from a considerable distance and represents a territory which is comparatively new, and I would move in nomination Mr. F. A. Bowman, of New Glasgow.

Mr. A. B. Smith: I do not know of any man to whom we are more indebted for the arrangements of this convention than Mr. Wilfred Phillips, and I have pleasure in nominating him.

Mr. Wickens: I beg to nominate Mr. Thompson, of Montreal.

Mr. Thompson: I would rather Mr. Browne would take the nomination instead of me.

Mr. W. H. Browne: I believe that I can be of just as much service without going on the committee, and I would rather that you would diversify your committee a good deal more as to locality. Mr. Thompson, I think, would ably and properly represent Montreal. We who are in Montreal will take care of the Montreal interests without being on that committee.

Mr. F. C. Armstrong: I nominate Mr. Reesor, of Lindsay.

Mr. J. Carroll: I nominate Mr. Cary, of St. Catharines.

Mr. J. J. Wright: I nominate Mr. A. A. Dion, of Ottawa.

Mr. C. B. Hunt: I nominate Mr. Wickens, of Toronto.

Mr. W. H. Browne: I nominate Mr. James Milne, of Toronto.

Mr. J. J. Wright: I nominate Mr. Dunstan, of Toronto.

Mr. F. C. Armstrong: I nominate Mr. Williams, of Sarnia.

Mr. Dunstan: I nominate Mr. George Black, of Hamilton.

Mr. W. Thompson: I nominate Mr. Browne, of Montreal.

Mr. A. B. Smith: I nominate Mr. Bayliss, of Montreal.

The President: The following are the names of the gentlemen who have been nominated: Messrs. Bowman, Phillips, Thompson, Reesor, Cary, Bayliss, Dion, Wickens, Milne, Dunstan, Williams, Black, Browne. I would name Mr. H. O. Fisk and Mr. J. A. Kammerer as scrutineers to count the ballots.

On a vote having been taken the president declared Messrs. Bowman, Browne and Thompson elected, there being a tie for the fourth and fifth places between Messrs. Phillips, Reesor, Dion and Milne.

On a second vote being taken the president declared Messrs. Phillips and Dion elected.

The President then called upon Mr. F. C. Armstrong to read his paper entitled "Why Some Lighting Plants Do Not Pay." (See page 117.)

Mr. Armstrong: Before proceeding to read this paper I would like to explain that it is very incomplete. Unfortunately the preparation of it was deferred until too close to the time of commencing the convention. I did not realize the scope of the paper, which really covers the whole lighting industry and operations in detail and in every other way. The first part of it was prepared and sent to press before I found that difficulty to the full extent, and I could not re-cast it, so I had to cut it in two in the middle.

Mr. Armstrong then read his paper.

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the following "S. K. C." Generators are in
operation and on order:

HAMILTON & PROUT, Forest, Ont.	-	-	-	-	-	-	-	30	K. W.
GEORGE H. DAVIDSON, Brighton, Ont.	-	-	-	-	-	-	-	30	"
GLEN WILLIAMS ELECTRIC LIGHT CO., Glen Williams, Ont.	-	-	-	-	-	-	-	30	"
LA COMPAGNIE ELECTRIQUE, Chicoutimi, Que.	-	-	-	-	-	-	-	40	"
TORONTO ELECTRIC LIGHT CO., Toronto, Ont.	-	-	-	-	-	-	-	60	"
" " " " " " " " " " " "	-	-	-	-	-	-	-	180	"
GRAVENHURST ELECTRIC LIGHT & POWER CO., Gravenhurst, Ont.	-	-	-	-	-	-	-	40	"
McMASTER BROS., Ridgetown, Ont.	-	-	-	-	-	-	-	75	"
FARNHAM ELECTRIC LIGHT CO., Farnham, Que.	-	-	-	-	-	-	-	30	"
SHERBROOKE WATER & GAS CO., Sherbrooke, Que.	-	-	-	-	-	-	-	60	"
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OWEN SOUND ELECTRIC & ILLUMINATING CO., Owen Sound, Ont.	-	-	-	-	-	-	-	50	"
SUSSEX WATER & LIGHT CO., Sussex, N. B.	-	-	-	-	-	-	-	40	"
CORPORATION OF MONCTON, N. B.	-	-	-	-	-	-	-	60	"
CORPORATION OF NEWMARKET, Ont.	-	-	-	-	-	-	-	50	"
CORPORATION OF SUDBURY, Ont.	-	-	-	-	-	-	-	75	"
A. GAGNON & CO., Victoriaville, Que.	-	-	-	-	-	-	-	75	"
BRANTFORD ELECTRIC & OPERATING CO., Brantford, Ont.	-	-	-	-	-	-	-	180	"
PETERBOROUGH LIGHT & POWER CO., Peterborough, Ont.	-	-	-	-	-	-	-	180	"
THE NORTH SHORE POWER CO., Three Rivers, Que.—Operating 12,500 Volts Transmission—	-	-	-	-	-	-	-	240	"
" " " " " " " " " " " "	-	-	-	-	-	-	-	240	"
THE ROYAL ELECTRIC CO., Montreal, Que.	-	-	-	-	-	-	-	300	"
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MONTMORENCY ELECTRIC POWER CO., Quebec, Que.—Operating 6,000 Volts—	-	-	-	-	-	-	-	600	"
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CHAMBLY MANUFACTURING CO., Chambly, Que.—Operating 12,500 Volts Direct—	-	-	-	-	-	-	-	2000	"
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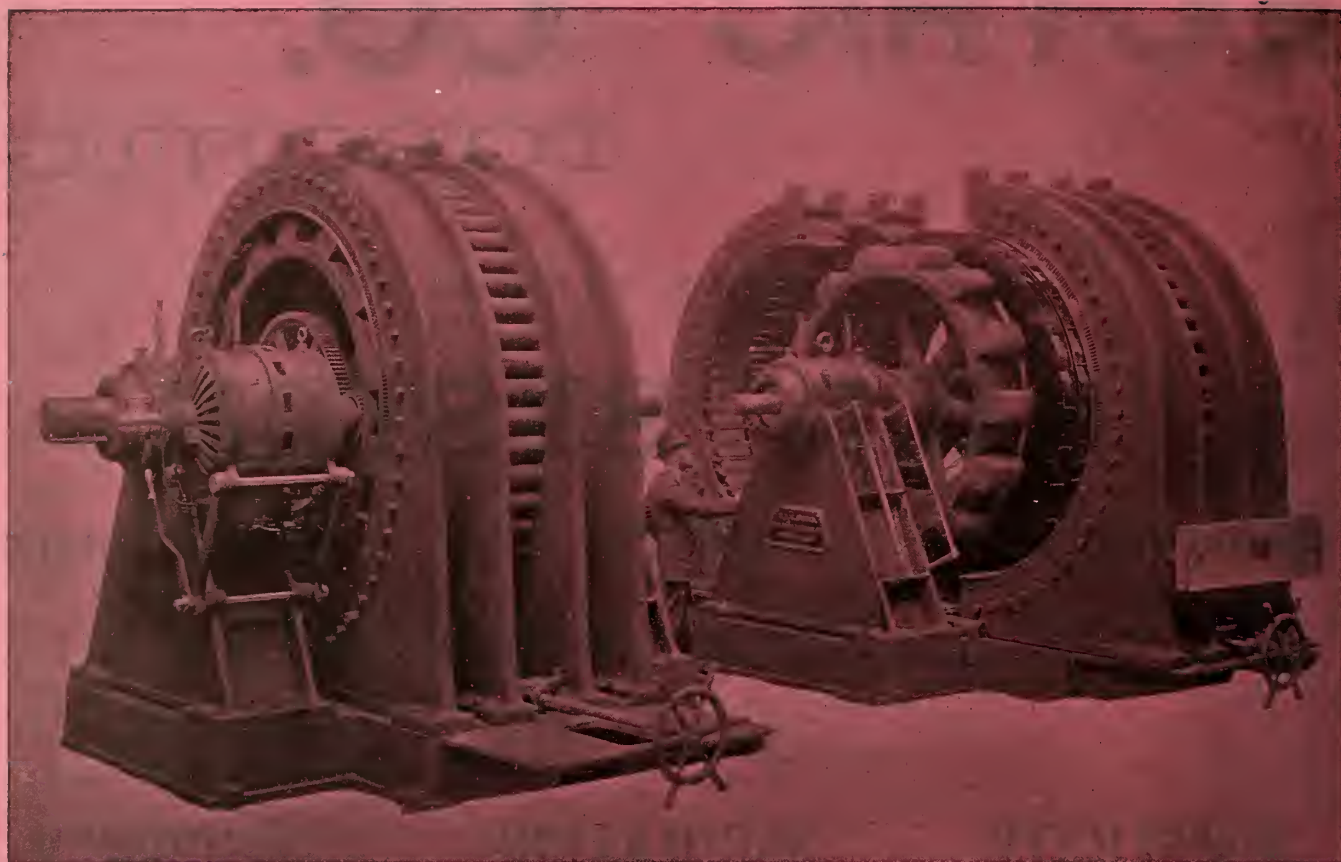
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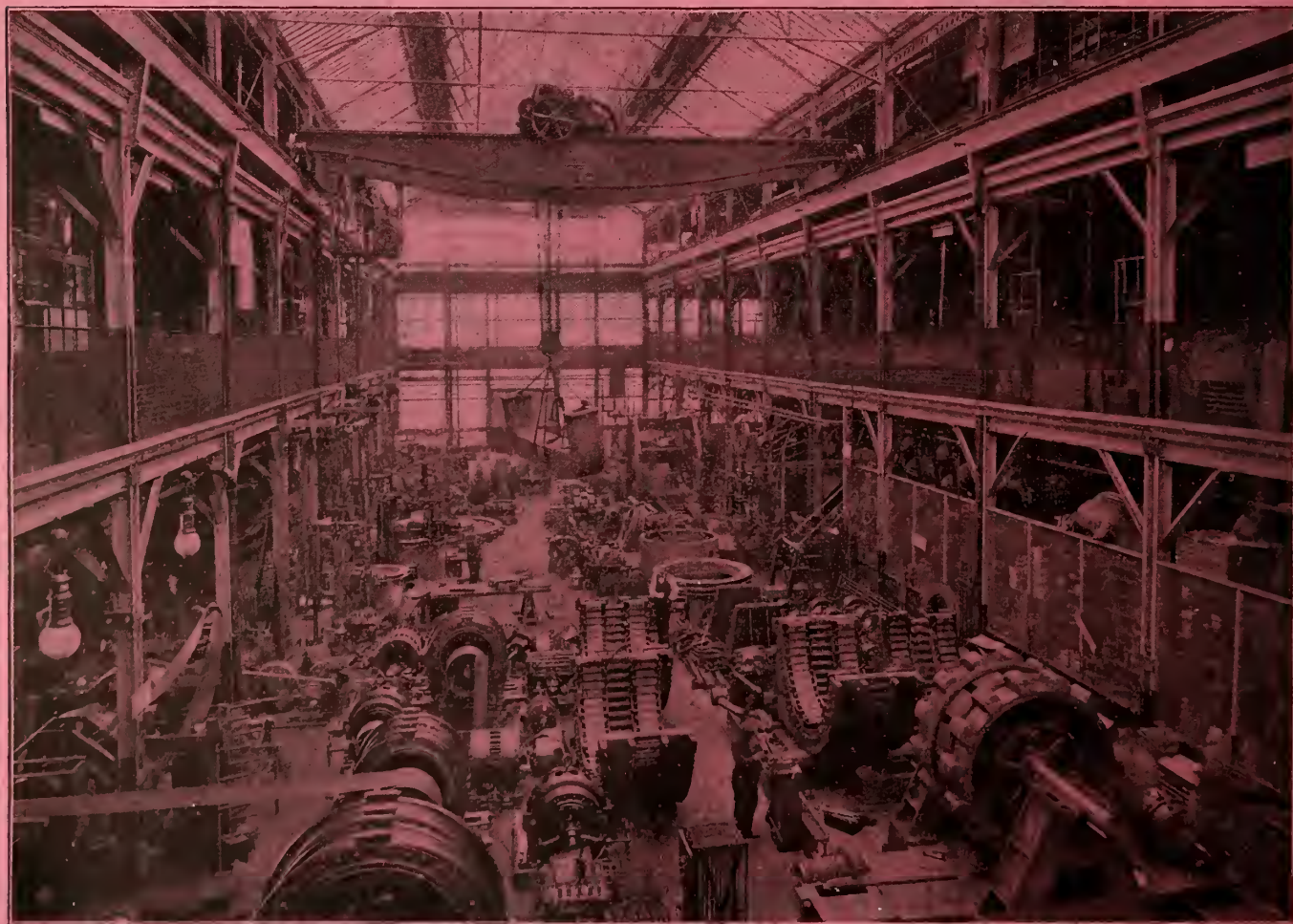
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TWO 600 K. W. "S.K.C." TWO PHASE SYNCHRONOUS MOTORS
to be used by the Montmorency Electric Power Co., Quebec, to drive generators for the Quebec District Railway.
Starting Motor shown in position on the closed machine.



THE ROYAL ELECTRIC CO.'S SHOP, MONTREAL.
The two 600 K. W. "S.K.C." Units for Quebec being assembled in the foreground.

Mr. W. H. Browne: I think that a most enthusiastic vote of thanks is due Mr. Armstrong for this paper. It is very ably thought out, closely and well put together, and nearly every item is worthy of the highest commendation. I think, however, that for the purpose of raising the discussion I will take issue with him on the question of meter rates versus flat rates. As I take it from this paper, he believes that the method of selling current by flat rates for small plants is better than meter rates, and that for large plants meter rates are better. In my experience I really find no difference between small and large plants. I think the same principles govern them all, and the experience that I have found with flat rates is that your maximum output is taxed to its utmost with less result in the income than by the meter system; in other words, by the meter system you are able to get a larger or higher amount in revenue than you can by flat rates. There is no way that I know of to check the consumption of current by your customers on the flat rate system, and the result is that you tax your load capacity, for the income returned, far beyond what it should be. I would recommend every man to serve his customers entirely on the meter basis, and starting from that standpoint to make a bid for the increased use of current on our hours; in other words, to make the rate for the first hour of service—I use that word because that is pretty nearly the average use with regard to residential and small commercial current—make the rate for the first hour of service such a one as will make a return on the investment and cost, and make your second, third and fourth hours of service exceedingly cheap. You will find very soon that the people are going to find means for using your current for lighting and power, because the cost beyond the first hour is so small that they can afford it; they become educated, and the result will be that you will get, instead of an hour a day average, probably about three hours a day, in your lighting service.

The President: How do you arrive at it in making out your accounts?

Mr. Browne: The idea is this: your customer has a certain number of lamps on his premises; you of course know how much that is; your meter ratings every month will tell you the number of hours of consumption; that will tell you whether that man's consumption has been one hour per lamp per day or more. Divide the number of lamps into the number of hours and the number of days, and for the first hour of service charge him your price, and for all the hours beyond that, whatever they may be, a lower price.

Mr. John Farley: That is the same as the gas company; they charge a certain rate up to 5,000 and then reduce the rate for the next 5,000 and the next 5,000 again.

The President: Not exactly.

Mr. F. C. Armstrong: In connection with what Mr. Browne has said, the method he speaks of is, I believe, quite general in England; it is practically giving a discount, as I understand, to the consumer, which is proportionate to his use of the current during a certain period. It seems to meet the difficulty from one point of view to a considerable extent, but my idea in pointing this out and taking the position which I did was to get the views of the owners of the smaller stations present who have had actual experience. One difficulty I have found myself in operating the smaller classes of stations in towns of 5,000 or less, is the failure to get sufficient annual revenue at all, on any basis of rates, that will admit of the use of light on the lamp hour basis. I would like to ask some of the central station men what their experience is, both those who have gone on the contract basis with a sliding schedule of rates, and those who have used meters.

Mr. W. H. Browne: I thought some of the gentlemen here operating small stations would answer more readily. I happen to have in my experience two small stations in which the flat rate system was in operation; one of them was a 1,000 light plant; the other was a 3,000 light plant. I changed both of these on to the meter system. I did not change them to the system I have just been outlining—for I confess that is rather a new departure with me—but I did put them on the meter basis, and instead of having a 1,000 light plant I obtained over 4,000 lights served from that same plant, and each individual customer paid a great deal less money, but I got a great deal more money out of my 1000 light machine on the meter basis than I could on the flat rate basis. When I asked a man \$3.00 a lamp a year he objected, but he might pay \$1.50; and on the meter basis he could pay \$1.50, and somebody else would pay \$1.50, and so I got out of my 4,000 lights a larger amount of revenue than I did out of 1,000.

Mr. S. Noxon: I am glad to see Mr. Armstrong has cracked a nut and exposed the kernel to view on a question which is of great importance to small central station managers. I was anxious to learn from the discussion here the relative merits of the flat rate and meter systems of selling electricity from those who have had experience, for the reason that we are supplying electricity upon the flat rate basis, and although we have discussed and pondered over this matter to a considerable extent the objections which seemed to present themselves to us were of such an insurmountable nature that we could not see our way to changing our system. And in this I will have to differ from Mr. Browne in his experience. I think it is easier to get a customer to pay a uniform rate per month on a flat rate than it is to get him to pay a large rate per month during the heavy lighting season, and a much smaller rate during the summer months, for the reason that the customer's attention is attracted very much more forcibly by the maximum amount he pays. The minimum amount cuts no figure with him; he does not realise that his average is a certain amount; perhaps he would if he figured it up, but the greatest trouble with most of our customers is that if you present a large bill to them they think it is outrageous. Now, I believe, so far as my experience is concerned, that you can do better upon a flat rate, and you can make your arrangements with your customers better

than you can with a meter system, for the reason that it is easier to make a yearly contract on a flat rate. On the meter system, on the other hand, your customer agrees to pay so much for whatever he uses; he naturally feels he should be in a position to either take your goods or leave them alone as it suits his fancy, and for that reason your revenue is much more stable under the flat rate than under the meter system. The only question which might arise is the gross revenue which you get. But as regards the feasibility and practicability of working the two systems in connection with a plant where you have keen competition from gas, I believe, and unless some argument is presented which will have greater force than those already presented, I still must be of opinion that in a small plant the flat rate system is better under all circumstances and conditions than a meter rate.

Mr. W. Thompson: I have the misfortune to be one of the small central station managers, and I have listened with a great deal of interest to what the gentlemen have said. I have at the present time both meter rates and flat rates, and I must say that the flat rates are an abomination to me; there are several reasons why. When we started in business we undertook to serve current by the flat rate, and in thinking it out it meant a great deal. The ordinary house, with us, gets about from 15 to 20 lights; and the houses being in a residential suburb are very much scattered. We had to provide alternating transformers and secondary mains. Where we put 20 lights in a house on the flat rate system we had to provide 20-light transformers and also a corresponding capacity on secondary mains. We very soon found that the capital outlay for putting in the extra transformers and secondary mains was going to swell up so much every year, and there was only one way to get over the difficulty, and that was to put in meters. We undertook to do that. The consequence is that on a 500-light machine I am able to put a thousand lights, and during four years I have never seen that machine loaded above 70 to 80 per cent. of its capacity. I venture to say, by cutting off the balance of my flat rate contracts and putting them all on the meter system, I could double that machine and still it would do its work. Not only that, but in one case I have two 50-light transformers working together and there are 200 lights working off that, and in the four years I have not even had the fuse broken. Supposing I had to provide current on the flat rate, with copper enough to carry over that amount of current, 200 amperes, and with transformer capacity enough, why, the capital outlay and the income from flat rates at 30 cents a month wouldn't pay the interest on the capital alone. Every ampere that we deliver into the residences or into business houses we are entitled to be paid for, at a fair rate; consequently we are entitled to be paid on the meter basis. I think so, and I strongly adhere to the principle, and I think if this gentleman (Mr. Noxon) would try the meter basis he would very soon find out which brought in the most money.

Mr. Armstrong: I cannot agree with Mr. Thompson, in spite of his statement that it is his own experience, which is somewhat modified by the fact that he is close to Montreal, and therefore governed by city conditions which exist, as to the relative desirability of the two systems. Speaking of my own experience, I know that in a majority of cases they do find it better, as Mr. Noxon points out, to make a contract on a yearly basis than to deal with meter charges, which vary so widely. And, going back to the point which I outlined in my paper, that is, what your meter measures, I believe when Mr. Thompson states that you should have pay for everything which passes through your meter, that would be quite satisfactory if you could measure it. But the measuring of ampere hours does not really represent the value of what is going through your meter, and that is just for the reason I have given in my paper. If taken off at 6 p.m., at the time of the maximum load, every unit you are supplying must pay its full proportion of what is invested for plant capacity; if taken off at a later period of operation it is not necessary to charge it with that proportion at all, and therefore it does not cost as much, and should not be sold for as much; it is really a different kind of unit, looking at it from a commercial point of view.

Mr. Pepler: I think this question comes home in reference to a small plant. Referring to our experience, I may say we had a flat rate, and our great trouble was that with the load we had to carry we had no possible way of checking the consumption. At the same time, we realized that it was the most popular plan. There is no question, it is easier to deal with customers on the flat rate than on the meter plan. However, all things considered, we determined to adopt the meter system, and we are now on that system, but it is not altogether satisfactory, more particularly with regard to the question of popularity. When you are in the hands of a municipality you have got to consider that question. We are now considering this scheme (partly by way of meeting the demand there certainly is for a flat rate—people say they want to know what they are about; that is the position they take—and partly by way of increasing the number of our small consumers): we are proposing to have a sort of combined plant; to continue the meter plan for large consumers and offer a flat rate to very small consumers, say, five or ten lights, at a certain fixed sum per year. We are also considering the advisability, in fact, we have concluded to do it, not exactly as Mr. Browne suggested, but to make a reduction to large consumers on the meter plan; a discount to consumers of \$75, and a still larger discount to consumers over \$100.

Mr. W. H. Browne: I think the difficulty of dealing with customers is very largely magnified. It has been my experience on the meter system to get into the business with a company that was serving entirely on the flat rate basis, and initiating the meter system. My clerks said to me, when the customers complained of the size of the bills, what are we going to do about it, Mr. Browne? I said we will adopt this uniform plan; in the first place, we will endeavor to get lamps that will consume a given

quantity of current—that we can know are within a certain reasonable range. We will insist upon our station men operating the plant within a reasonable range of pressure, so that we will be able to know that a given number of lamp hours, when burning, should represent a given number of hours of registration; that will be our first work; and when we have done that we will say to our customers: If you find any fault with your bill consult your meter; read your meter; you can read it as well as you can read your clock. I adopted the uniform plan of making a test for a given number of hours with all the lamps burning, and reading and comparing the number of hours by the registration of the meter. That plan has always succeeded; the man never complained the second time; he was able to go and read his meter, and check it up every day. Not only that, but the managers of large places who are dependent upon their employees for the turning on and off of their light are able to use the meter as a means of checking their consumption by their employees. In one notable case that I had in my experience, the manager of a large institution had every meter tabulated and had printed forms showing the number of lights connected, and what they were, and the registration of them presented to him every morning, so that he was able to know exactly whether there was any use or abuse of the lighting. The great trouble we find in the business is that our commodity is too expensive. It is a luxury, and our efforts should be to offer it to the public so that they must buy it of necessity, not as a luxury. The flat rate system insists upon a high price as the first requisite, whether the man wants to use the light or not, and he objects. But if you say to a man, take this light and use it just as your needs and your pleasure dictate and pay for what you use, his individual bill is less than it would be by the flat rate; and it simply requires to make the man know that he has to pay for what he burns to get him to use it. You can get \$1.50 per lamp out of a man easier than you can get \$3. He is apt to look upon the meter system as he looks upon meters in connection with gas. But let us take the position and say: Gentlemen, we have a commodity to sell; we are honest about it, we want you to measure it and check it up and pay for what you use. Charging by the flat rate is not honest, it is not fair to the consumers or to the electric light man; it is not fair to the consumer in the summer time who does not need to burn it, and yet has to pay for it; it is not fair to the consumer in the winter time to pay \$10 when he has only used \$3 worth. We should cultivate an increased use, not by making a discount on it for the sake of the dollars in it, not because a man's bill is \$75 or \$100 a month; that is a matter of no consequence; the man that pays you \$75 may not be as good a customer as the man who pays you \$5. The man who uses your current up a great many hours of the day is the man you want to make the price for, so that he will be obliged in self-defence to buy it. I recommend to the consideration of all here the idea of getting the electric light down to a lower price. I believe that will be the way in which central stations will pay.

Mr. B. F. Reesor: I am thoroughly in sympathy with this idea of using meters; as fast as we can we are working into the meter system. Of course, you understand, you get all kinds of stories; there is a good deal of talk about the meters with a good many people; they think they would rather pay a flat rate because they say we want to know what we are paying for. The answer to that is, go to your grocer and ask him what you are paying for groceries per year; why, the man would laugh at him. In the flat rate system, as you all know, you have got to make a rate and allow for waste in stores, etc. In the business portion of the town where one man has a rate he pays a certain price and we have got to charge him more than we naturally would charge him because we expect him to waste his light. In letting his lights burn it is an advertisement as far as he is concerned. If he had to use coal oil or gas he would not use those lights after hours. When he has a flat rate he lets them go as long as they like. The next man to him has a meter in; he closes up his place of business and shuts off his light. If there is anything unusual going on and he wants to advertise his store front, he turns on his light and is willing to pay for it, as far as the meter rate is concerned. I quite agree with Mr. Browne that we should make our rates low; people will use more. Just before I left home I closed a contract with a large firm in this way: We put in a certain number of lights in his mill and charge him a minimum rate per year; he thinks he will run all night at times—24 hours a day. They start at six in the morning and run until six at night. Then in the fall of the year they have to light up when it gets dark after six, and then in the morning when they start up they have to light up, putting out the lights at daylight. If they run all night they will use a great deal more current, and the contract is that we charge him a minimum rate per year; if he does not use an ordinary amount of current he must pay so much; if he uses a certain quantity we give him a discount off. We give a discount, in any case, if the account is paid before the 10th of the month. If he uses a larger quantity he gets a larger discount, and we make the rate low. We do the same thing with other customers. Some of those who have mills talk the same way; they say we do not want to have a meter because we have no confidence in them; we do not think they will register right; we have had experience with gas meters and all that kind of thing and we want to know what it is going to cost. And I say, go to your grocer and buy your groceries that way.

Mr. F. A. Bowman: I have been using meters now for about five years; we have flat rates as well, but our object is, as fast as possible, to work our customers on to the meter rates. We take no customer using over four lights on anything but the meter system. My experience is that it reduces the consumption of light. You can over-wire very much more largely when you have a number of meters in than you can under any other conditions. When we

make flat rates we base them on what we consider would be a fair average consumption through the year; you cannot give more than a few different kinds of rates, and the result is a great many of the customers through carelessness consume a very much larger amount of light than your rate is figured on. I know you have to keep constant watch or else you will find them leaving the lights on; you will find a customer leaving his lights on every night and letting them run all night, and things like that. I know of an instance, fortunately not my own, in which every store in the town is left on till the plant is turned off. My customers use me very much better than that, and as a rule they shut their lights off; still, you have got to watch them to a considerable extent. Take houses on meter rates and on flat rates, and I think you will find a very great deal of difference; you take an ordinary sized house, it has between 20 and 30 lights; if you put them in on the meter system there are about two, three or four lights in the house that practically make the meter bills for the month, say in the front hall, the sitting room, the kitchen and perhaps the dining room; the rest of the lights are used comparatively little and they cost the man practically nothing in the year. You give that customer a flat rate and go past that house on an evening and you will find three-fourths of the lights in that house turned on from dusk until bed-time. I think I saw it stated in an English paper that when lighting residences on the meter system you can depend on the consumption, that is to say, the number of kilowatts going out at any time, as being about 35 per cent. of what you are wired up to. When we give flat rates most of us figure on 16 c.p. lamps, whereas on the meter basis we can figure on 5 c.p. and 10 c.p. Although the lamps are not quite as efficient as the higher class of lamps, on the whole I think we will generally find it to our advantage to get meters introduced into the small plants as fast as possible. You know a great deal better what you are doing and you have the certainty that you are getting paid practically for all that goes out. I might say in this connection that I have rather a unique scheme; I have a small town where I am lighting the streets on the meter system; in other words, we put in an independent circuit, on a three-wire circuit, centered at the town hall, and they have a meter and switch of their own and simply turn the lights on and off whenever they like. We have no contract with them. As a result, I think they are satisfied. The arrangement has been running about a year and a half now, and they gave me an order to put in very considerable extensions to the system, so I think they are tolerably well satisfied.

Mr. H. O. Fisk: In regard to the flat rate system, we ran against a snag that I have not heard mentioned; we started with a contract for 16 c.p. lamps at a certain rate, then 10 c.p. at a certain rate, and we found after a while there were a great many 10 c.p. used. They said they were as good as 16 c.p. lamps. This thing went on in this way for a year or so, the load got tremendously heavy, and the income didn't come up, so we put an unknown man on the road to investigate. He went around and looked at all the lights and the result was that about ninety-eight per cent. of our 10 c.p. lamps were 16 c.p. The company then decided they would have no more flat rates for anything except 16 c.p. lamps; so they made a contract for 16 c.p. With reference to the meter rate, I might say we made a discount about a year ago of 33½ per cent. of what we were charging, for all bills paid before the 10th of the month. The result was that by the 10th, or at the latest the 11th of the month, all our bills with the exception of perhaps one would be paid in cash in the office, and that one you could look out for, because if he didn't wish to take advantage of the 33½ per cent. you could watch him. I might say also that in a year we almost doubled our number of units in that way, and we find that that load is the best paying load we have got. We get a larger return for the number of amperes put out than we do in any other way.

Mr. S. Noxon: I understood Mr. Browne to say that by using the meter he would make a reduction in price, and that his revenue came up even in spite of that on account of the extensive use of the light under the meter system. I would like to know how that operated. Of course there are two items in the calculation as between the flat rate and meter rate, and that is the relative price you get for either. It doesn't make any difference how "flat" your rate is providing you get money enough. It is all a matter of revenue for the service which you give. If you mean by a flat rate that you are going to get \$2 a lamp for every lamp installed, there is no doubt you would not get much of a revenue, but if you get \$4 you will have a pretty good revenue. If you are safe in having your installation from 25 to 40 per cent—

Mr. Thompson: In residential work you might safely double the capacity.

Mr. Noxon: That is so much better for the argument of the flat rate. If you are safe in installing double the capacity of your dynamo, as Mr. Thomson said, on the meter basis, will it not apply to the flat rate?

A number of voices: No, No.

Mr. Noxon: If you are safe in installing double the capacity of your dynamo, then, of course, you can make your rate less to correspond with the cheap rate which you would have to give on the meter basis?

Voices: No, No.

Mr. Noxon: Why not? If you can depend upon their only using half of the output, it will amount to the same. If you can depend upon that, why can't you make your flat rate correspondingly less? Where are you in any worse position? Now, what I say about the flat rate is this, and as we have not discussed the price of the flat rate, my argument on the flat rate holds perfectly good until the price is established. After the price is established, then it is a question whether that price will pay or not. If you have a 1,000 light machine and you can install 2,000 lights and

can get \$2 on a flat rate for these, you get \$4,000. Can you get any more on your meter system?

Mr. Browne: Certainly you can, and the objection to your argument is this: You say, establish the question of a flat rate without regard to price, and you can double your installation. The lower you make your price—

Mr. Noxon: I said, when the price comes to be discussed it might change the conditions. What I say is this, that providing you can get a rate on the flat rate basis which would equal your income from your meters, then where are you at an advantage?

Mr. Browne: Leaving the question of the price out, the lower the price is on the flat rate basis the less chance there is of overwiring. The only way that you can secure the opportunity of overwiring would be to charge a high price on the flat rate. Mr. Bowman told us a little while ago that in England the experience is that on residential lighting 35 per cent. of the lamps installed is the maximum load. That is a high percentage. In my personal experience, I had a plant in which we had no residential lighting of any kind; it was entirely commercial business, hotels, saloons, theatres, stores and so on, and the maximum burning at mid-winter, in holiday times, did not exceed 60 per cent. of the lights wired on the meter. My experience in residential lighting is, although Mr. Bowman says it is 35 per cent. in England, that it does not equal 30 per cent; in other words, you will have 1000 lights wired up and 300 is the maximum burning. Therefore, you are able to serve all of your customers with your 300 light machine, and you are able to get your revenue from the full capacity of that machine. You have not got to put in a thousand light machine to serve a thousand customers. You are not going to get the revenue out of your machine on flat rates that you will on meter rates.

Mr. Noxon: This is a question in which I think not only myself, but a considerable number, are interested. What I wanted to satisfy by this discussion is this, that what Mr. Browne says is correct, that you are safe in wiring up three times the capacity of your machine. We have lately put in a thousand light capacity, and I want to know if it is the opinion of those who have had experience that we are safe in wiring up to the extent of 3,000 lights on this machine?

Mr. Browne: If you use the meter basis. If you have residential lighting and commercial lighting together you can easily wire 5,000 lights on a thousand light capacity.

Mr. Bowman: It looks to me as if somebody is investing a great deal of money in this thing that is not going to bring great returns. If your machine is employed only to that proportion of its capacity, I cannot see where the revenue comes in unless somebody is paying a great deal more for their light than they should be.

Mr. Browne: In answer to your enquiry as to how much you may wire: In the city of Montreal to-day we have wired up on our circuits 65,000 lights; we are serving those lights with five 300 kilowatt machines, that is 1,500 kilowatt capacity, and we always have one to spare.

Mr. Thompson: I think Mr. Noxon really misunderstood what I said. I meant to say that on the meter system I was quite safe, (and that has been pretty well borne out from facts, and I know from four years' actual observation and experience that I have proof of what I say) that I could safely, on the meter system, put on 2,000 lights on my machine. Now, supposing that I sold those 2,000 lights on the flat rate, and that all our customers were perfectly honest—unfortunately a lot of customers, when you put them on a flat rate, use 16 c. p. lamps instead of 10, and I have known them to use 32 c. p. instead of 16; I have known them to pay for 15 lights and install 25—you may take it for granted with the most honest of customers that at some time during the night you are going to have your full maximum of 2,000 lights on, consequently you must provide 2,000 light apparatus. What does that mean? It means that your 2,000 light apparatus is simply bringing in the income that you could bring in on a 500 or 1,000 light apparatus.

Mr. Armstrong: This discussion seems to have drawn out considerable discussion; those who are in favor of the meter system stick to the point that they are right, and the other gentlemen express themselves with equal confidence. It simply establishes the fact that it is all a matter of conditions. What I contend is, and the purpose of my paper was, that for small plants—I mean plants in towns of from one to three, four or five thousand people—the contract basis has proved itself in actual operation to be very satisfactory. I have in my mind the case of the town of Penetanguishene, where the plant installed was put in some four years ago; it was put in on the basis of the idea which Mr. Browne has just expressed, and which at that time was very clear in my own mind, that the way to make money out of the electric light business was to sell the light cheaply. In establishing the rates a good deal of care was taken to make the sliding scale equivalent to a meter basis. The result is that that has paid the stockholders very handsomely. The system has been extended as far as the size of the town will permit, and they have some 1,700 or 1,800 lights. A fact that has been established is, that on the basis of charging for lamp renewals you can very largely realize the conditions of the meter plan. With respect to overloading machines they have, up to the present, without any difficulty, been able to operate that number of lights from one 60 kilowatt alternator. I know also of an example in residential lighting where they have about 50 or 60 lights in, and on an average they do not use more than half a dozen or eight lights; there is no object in keeping their lights blazing all through the house. I could give instances of a large number of similar cases in towns of a similar size where by the flat rate system they have realized nearly the same conditions as under the meter system; where, so far as making money is concerned, the flat rate

approximates closely to what a meter rate would be. Then you have the expense of meters, which is quite a capital charge on the plant. Then, under the flat rate, you have the advantage of a clean cut business; you know what your revenue is going to be to a dollar, and the only increased cost which the contract basis may allow an opportunity for is the increase in fuel, and that is not, in a small plant, very large. I do not wish to be understood at all as saying that that applies in all cases. In all the larger plants and in some special cases with the smaller plants, a meter basis is not only desirable but necessary. But I am speaking generally for a certain class of small stations, some of which, I think, are represented here, and from the owners of which I would like to have heard an expression of opinion.

Mr. J. M. Brown: It seems to me this question is largely a matter of expediency with regard to small plants. I happen to run a small plant in Carleton Place. When we started out we had the idea of putting all the residences and as many of the stores as possible on the meter basis. They did not run very long until they began to kick and said their returns were too light. I came to the conclusion then, that in order to work up a business, it would be better for me to adopt a flat rate right through. We did so and gave a very reasonable rate, and we have, of course, installed more lamps, but I can clearly see that in the near future my plant will be loaded up and I will have to go back to the meter basis or else put in more apparatus. Now, there is another point: I think that for commercial business in a small town you have got to have a flat rate for the simple reason that a good many stores close, say, so many nights a week; and I even know of one town not very far from me where only last year they closed all their shops at six o'clock in order to cut off the electric light and heat. In that case they were running on the meter basis. If that town were on a flat rate they would have been getting an assured revenue from commercial lighting. I think for commercial lighting you should have an assured return to pay for the capital involved, to carry that amount of lighting. For residences I believe it should be run on the meter basis, and on the meter basis only, to be satisfactory to central station men. At the present time we are running them half on the meter and half on the flat rate, and I know for a fact that those who are on the flat rate are using three or four times the amount of light that the other people are, and I am getting very little more money from them. I can take residences that have 50 lamps on the meter system, and they are not using, on an average, through the heavy lighting part of the evening, more than 10 lamps. Other residences with a less number of lights in, on the flat rate, are using frequently 20 lamps right through the heavy lighting part of the evening. They do not always do so, but they frequently do. In any event they use nearly double the amount of lamps that residences do that are on the meter system, and I get very little more out of them. So that I believe the meter rate is the only practical way to get over the difficulty in connection with the residence portion. But, from our own standpoint, I prefer the flat rate for commercial lighting. You could not get hotels on the meter basis at all; they would not use the light no matter how low a rate you gave them, for the simple reason they claim they have no control over their light. We get the commercial rate from hotels, and although they use a considerable number of lamps all night, those lamps are on when the load is light and the power is not of so much consequence to us; it doesn't tax your capacity in any way, and you get a good revenue from them. If you put them on the meter system they would not stay with you at all, for they could not stand it.

Mr. Thompson: I beg to move a vote of thanks to Mr. Armstrong for his excellent paper that has brought out so much discussion. I am sure we have all appreciated it very much.

Mr. Noxon: I beg to second that.

The President: I have great pleasure in tendering to you, Mr. Armstrong, the vote of thanks from this meeting. We would ask those who prepare papers for the next convention to choose subjects that will evoke discussion and difference of opinion, and bring out what the experience of different members is in different localities.

The President: I will now call upon Mr. C. E. A. Carr, of London, to read his paper entitled "The Commercial Aspect of Electric Railways." (See page 122.)

Mr. Carr: Mr. President, gentlemen and members of the Association: The subject of my paper as announced on the printed sheets is rather misleading, as the paper was written before I had the subject sent to me, therefore it appears on the paper "Electric Railways, and How to Make Them a Commercial Success." I do not know that the paper will have as much interest to most of you as the paper read by Mr. Armstrong, because not many of you, I understand, are very closely connected or associated with electric railways.

Mr. F. C. Armstrong moved, seconded by Mr. W. H. Browne, that a vote of thanks be tendered to Mr. Carr for his valuable paper.

Mr. Browne: Mr. Carr, from a railway standpoint, has amplified what I think is a necessity with all businesses, namely, good employees and loyal employees, who make themselves interested. This is necessary to the success of electric lighting, railroading or any other business.

The President at this point called upon Mr. W. A. Johnson, of Toronto, to read his paper on "Accumulators—Their Application to Central Station Lighting and Power." (See page 125.)

Mr. C. B. Hunt: I have very great pleasure in moving a hearty vote of thanks to Mr. Johnson for his valuable paper.

Mr. J. Farley: I have much pleasure in seconding the motion. While all the papers have been, to my mind, exceedingly interesting, there is none probably that has a more practical bearing on the future than the one just read.

Mr. W. H. Browne : Before passing the resolution, I notice that the question of the cost of installation was referred to, but nothing said, I believe, as to the cost of operation or maintenance account. Could you add anything on that line, Mr. Johnson?

Mr. Johnson : I refer to the question of maintenance very briefly here. I simply stated that it had not been found to be excessive. So far, for about three years on the North American continent, during which time the modern type of battery has been in use, the cost of maintenance has been found in central stations to give good evidence that repairs will not exceed from three to five per cent. of the cost. The manufacturers give a perpetual guarantee that the cost will not exceed 10 per cent. in any case. It has been found in all the more recent stations installed that the companies purchasing have availed themselves of the privilege of doing their own repairs, and if there is any difference between that and 10 per cent. they save it. But there is a definite guarantee of 10 per cent. given in all cases where they expect the plant will receive reasonable usage. I have no further figures than these. I may say, however, that in several plants in Canada these figures have been found to hold good.

Mr. Browne : The object of my inquiry was, I had understood that manufacturers of storage batteries were willing to guarantee that the maintenance or repair cost was considerably lower than 10 per cent.; in fact, I have heard them declare that they would guarantee 3 per cent.

Mr. Johnson : It is possible it is so now, but instructions have not been issued up this way to that extent.

Mr. Browne : If it does not exceed 10 per cent. it goes without saying that we must use the storage battery. I have had in mind for some considerable time the utilization of the storage battery in connection with our station. I know the experience with it in



MR. JOHN YULE,
President Canadian Electrical Association.

New York is that it is satisfactory. The only element which is uncertain is as to the fixed amount of repair in operation.

Mr. F. C. Armstrong : The field for the storage battery is unfortunately confined to direct current work. How would you get over that difficulty, Mr. Browne?

Mr. Browne : My way of using it is by operating a direct current machine and charging my battery, and in return operating a motor to drive an alternator. I am calculating on having an efficiency of 50 per cent. from the plant. I believe I can afford to do it.

Mr. Johnson : I might say that there is no doubt there are a number of cases where alternating current dynamos are operated by water power some distance from towns or cities where the current might be delivered through the city and rectifiers used to charge the batteries or rotary transformers, and the capacity of the generating plant and the transmission line be kept down. The distribution could be handled fully as easily, perhaps, with the same generators as through the usual alternating circuits; that would apply especially to a water power that was not extremely large.

The President : It has been moved by Mr. Hunt, seconded by Mr. Farley, that a hearty vote of thanks be tendered to Mr. Johnson for his paper. Carried.

The President : The paper by Mr. Keeley on "Economy in Circuits" will have to be taken as read. (See page 120.) It will appear in the report of the proceedings of the convention.

A vote of thanks was tendered to Mr. Wilfred Phillips for his untiring and valuable efforts for the success of the convention, and for the complete arrangements made for the entertainment of the delegates.

Votes of thanks were also tendered to the press for the accurate reports of the proceedings of the convention, and to the following for courtesies extended : Niagara Falls Park and River Railway Company; Buffalo and Niagara Falls Electric Railway Company; Buffalo Railway Company; Suspension Bridge Company;

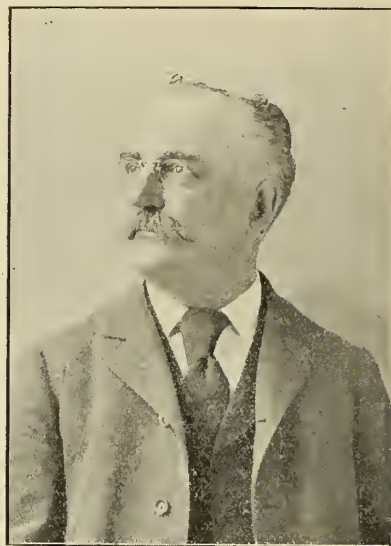
Niagara Navigation Company; Captain Carter; Niagara Falls and Suspension Bridge Railway Company; Niagara Power Company, and Hydraulic Power and Mfg. Company.

Adjournment was then announced by the President.

SOCIAL FEATURES.

On Wednesday morning an excursion to Buffalo took place, which was well attended. Great interest attached to the inspection of the power station of the Buffalo Railway Co.

The annual banquet was held on Thursday evening at the Dufferin Cafe, and was a marked success. About 125 members and their friends were present. Mr. John Yule presided. Letters of regret were read from Hon. A. S. Hardy, premier of Ontario; Hon. J. M. Gibson, Commissioner of Crown Lands, and several others. After Her Majesty had been duly honored,



MR. C. B. HUNT,
First Vice-President Canadian Electrical Association.

responses were made to the various toasts as follows : "Our Guests," Mr. Wilson, of the Queen Victoria Niagara Falls Park Commission, Mr. Lincoln, of the Cataract Construction Co., and Mr. Innes, of the Guelph Light and Power Co; "Electrical Industries," Messrs. W. H. Browne and H. P. Dwight; "The Ladies," Mr. F. C. Armstrong; "The Press," Mr. W. Johnston, of the Electrical World; "The Mayor of Niagara Falls," Mr. Cole; "The Presiding Officer," Mr. John Yule.

The closing day was devoted entirely to sight-seeing. Starting at the Hotel Lafayette, the party were conveyed by the Niagara Falls Park and River Railway to "Rapids Views," Brock's monument, and Queenston. Crossing the river to Lewiston, a trip was made on the gorge railway. A visit was also made during the day to the power houses and works of the Cataract



MR. J. A. KAMMERER,
Second Vice-President Canadian Electrical Association.

Power and Construction Company and the Niagara Falls Hydraulic and Power Manufacturing Company, and the expedition wound up by a trip on the Maid of the Mist.

Amongst the visitors to the recent convention of the Canadian Electrical Association at Niagara Falls, was Mr. William McCulloch, formerly with the Canadian General Electric Company, now the representative of Mr. Hugo Reisinger, 38 Beaver street, New York, who is the American agent and importer of "Electra" carbons, manufactured at Nuernberg, Germany. These goods will be on sale in Canada by the Canadian General Electric Company, and Mr. McCulloch hopes to establish quite a business in this country. These carbons do not come in competition with American or Canadian made goods.

WHY SOME LIGHTING PLANTS DO NOT PAY.

By F. C. ARMSTRONG.

BEFORE proceeding to a discussion of the subject proper of this paper, it is necessary to fix a standard by which it may be determined whether a given plant is paying or not. A fair definition taking everything into consideration would seem to be that a plant which earns twelve per cent. per annum or over on the capital investment, which at present prices of apparatus and material would be required to provide an equipment of equivalent earning power, should be considered as a paying investment. In this definition we imply that 6 per cent. net per annum is a fair return for money invested in an enterprise of this nature; that 6 per cent. per annum is under present and prospective conditions a reasonable and sufficient allowance for depreciation; and that the capitalization upon which these charges are made should suffer the material and arbitrary reduction necessary to bring it down to the basis of present selling prices of electrical equipment. Regarding the first of these postulates a strongly affirmative view may be taken. Electric lighting has established a reason for being beyond question, amongst modern industrial enterprises. Abundant artificial illumination for safety, need or convenience has become an indispensable requirement of our present multiplex civilization. The electric light supplies this necessity, it is safe to say, in spite of Welsbach burners or acetylene gas, more completely than any present or as far as we can see any possible competitor. The central station is a shining example of the sound economic principle of concentration of production and diffusion of output which means commercially that under most circumstances it is cheaper to get your light from a central station than to install an isolated plant. It may, therefore, fairly be conceded that, whatever may have been the vicissitudes of the past, the money invested in a central station to-day is entitled to take rank as a safe conservative and first-class investment from which a return of 6 per cent. per annum should be regarded with satisfaction.

The sufficiency of the allowance of 6 per cent. to cover depreciation is more open to discussion and in it is really involved as well, the soundness of the third assumption. In order to clear the way to a fair consideration of this matter it must be kept in mind that the depreciation of electrical apparatus in the past, and to a measurable degree in the future, is of two distinct kinds. The first is in the depreciation proper, due to the wearing out of the machinery and appliances in service; the second, and in the early days of the electrical art vastly the most important is the arbitrary depreciation which is due not to the wearing out of the plant but to its becoming obsolete by reason of the introduction of newer and more efficient and satisfactory types. There can be no question but that the unparalleled rapidity of development of electrical science and the electrical industry which has crowded the progress of a century within one decade and a half, has borne heavily upon the earlier investors whose faith and courage made this marvellous progress possible. The apparatus produced in the tentative stages of electrical evolution was naturally crude and often unsuitable for the purpose for which it was sold, since the principles governing its operation were only dimly understood or guessed at, and that often incorrectly. Considered in the light of present standards, the units in use were, in view of subsequent requirements, absurdly small; the commercial efficiency of generators, distribution lines and transformers when used was very low; regulation, with all which it entails in plant efficiency, was practically non-existent. The steam plant on the market too was in a much less advanced stage of development than at present, and the relative suitability of varying types had as yet to be determined. Contrasting with this the present condition of the art, we find that in the best types but little room is left for improvement along present lines. The efficiency of the best dynamos of to-day is exceedingly high, 90 per cent. or better at full load being an ordinary guarantee for even the smaller sizes. Regulation in the best ma-

chines, both for incandescent and arc lighting, is practically perfect. As an example of the stability to which the highest grades of apparatus have attained by a gradual course of evolution, we may instance a widely-known machine—the ironclad armature type of alternator, as constructed by a number of the principal manufacturing companies. Experience has established its perfect adaptation to the purpose for which it is primarily intended—the supply of alternating currents for incandescent lighting. Its design renders possible the highest attainable efficiency at all loads; the regulation by the simple device of compounding provides compensation not only for armature reaction, but also for line and transformer drop, ensuring an even potential at the lamps, and permitting the use of lamps of ten, twenty, or thirty per cent. higher efficiency than was possible with hand regulation. The ironclad construction of the armature secures perfect mechanical protection of the conductors buried in the slots, and these are made easily removable for repairs in case of damage. The high self-induction caused by burying the coils beneath the iron of the armature affords the best possible protection against burn-outs by lighting or short circuit. The single phase system for which these machines are designed is admittedly the simplest and most economical for lighting distribution. Altogether, therefore, it is evident that this machine, which is selected simply as a familiar type, has proved itself in experience to be admirably adapted for the work which it is called on to perform.

Setting aside all unessential peculiarities in design, by which one or another machine or appliance may be recommended as against that of a competing manufacturer, there can be no question that for both incandescent and arc lighting the best types to-day are practically perfected for the work which they are called on to do, and have therefore reached a reasonably permanent and stable form. This being the case, the arbitrary depreciation charges to which an investment in electric lighting plant was formerly subjected are no longer to be feared, and that the depreciation due to the natural wearing out of the machinery in service is covered by the allowance made for that purpose, no one will probably be inclined to dispute. In the matter of current prices, whilst improved methods of manufacturing and the keenness of competition may be expected to cause from time to time some further reductions, the bottom may fairly be said to have been touched in most lines of standard supplies and machinery.

Involved in the foregoing, at least by inference, is of course the conclusion that the wasted capital represented in the balance sheets of most companies by obsolete and discarded plant bought at the high prices of the early days should be wiped out; if not by the summary process of reduction in capital stock, at any rate in so far as it affects a reasonable and just decision as to the profitable nature of the field offered by electric lighting under the conditions which obtain to-day.

Having thus defined the standard by which we may judge whether a lighting plant pays, we may now indicate briefly some of the causes of failure to realize the modest basis of earning power which we have set forth, and which is the very lowest which can be regarded as satisfactory. The matter is too large for proper treatment within the limits of a convention paper, even with its scope restricted by leaving entirely out of consideration the central stations of the larger cities. I shall therefore only attempt to suggest by touching very generally on some of the more evident cases and causes of failure, a set of conditions the real root and remedy for which will be apparent to the experience of the members of this Association.

The subject naturally divides itself into two sections, the one, failure by reason of mistakes in management and business methods; the other, failure through mistakes in engineering and the actual operation of the plant itself. In the first, a sufficient cause for the non-success of the enterprise is often found in the personnel of the management. In this respect central stations are of five classes: the first, those which are in charge of a manager or superintendent who may be specially trained for the work, and who devotes his attention ex-

clusively to it; in the second place, those whose management is in the hands of a man who divides his time between it and his other business interests; the next is the large class of small stations which manage themselves, with occasional interference on part of the owner; in the fourth place, and I say it with due deference, we have the lighting stations which are run as appendages to a gas plant, by a gas manager, and which, treated with the care and indulgence which falls to the lot of a necessary evil, make precisely the return on the investment which might be expected. There are notable and happy exceptions, but I regret to say that the rule with this class of station is as I have stated. Finally we have that Ishmael amongst lighting stations, which its enemies say always, and its exponents say never, comes under the caption of this paper. I mean the municipal plant. In it we have quite often an ingenious combination of all possible methods of mismanagement.

Speaking generally on this point, it will, I think, be admitted that there is to-day no industry representing an equivalent money investment, and possibility of public service, which is so generally managed by men who know little or nothing about it. But the special knowledge and training which comes with experience is in a new business not readily obtainable. The ideal manager will come with time; some of him is here to-day.

The electric light is a manufactured commodity offered for sale to the public; for it there exists in each community, a certain possible maximum sale; and with it to a greater degree than with most other manufactured products, the cost of production per unit is reduced as the output is increased. The question of rates is therefore an all-important one in deciding the earning power of an electric lighting plant. I will venture the assertion that in most flagrant cases of plants which positively refuse to show any margin on the right side between gross revenue and operating expense, the remedy lies in cutting down the rates to the point which will force a large increase in the business. A plant which supplies 200 lights at \$10 each per annum has a revenue of \$2,000 per annum and may not pay; the same plant, if increased to 1,000 lights at \$5 per annum would probably be paying handsomely.

It is evident also that, like the telephone, central station electric lighting is a natural, and when conducted upon proper lines, a beneficial monopoly. The supply of current for lighting and power within a certain area can unquestionably be carried on more economically from one than from two or more competing stations. The benefits of such economical production may be shared alike by producer and consumer. When such is the case the security for the investment rests on the soundest possible basis, the rates being brought low enough to realize the fullest development of the business within the prescribed limits, the satisfaction of the public being ensured, and plainly no opening for profitable competition being left in dividing up a business which, even when extended to the utmost limits, and therefore carried on under the most favorable conditions, affords only a reasonable profit on the money invested.

In connection with rates and the field for business, the arc light contract properly comes up for consideration. Its value now-a-days to the average station is very doubtful. The development of the incandescent lighting, and more lately the power business, has established a reasonably secure and permanent market for the output of the central station, and to this fact more than any other are due the improved conditions now noticeable in the industry. It is unfortunately true that a large proportion of the existing investment is in many cases represented by dynamos, lamps, poles, lines, etc., which are valueless except for the purposes of the street lighting contract, but even under these circumstances it would in most cases pay the lighting company far better to devote their energy and plant capacity to a development of their proper and permanent business, adding whatever new capital may be necessary to properly equip them for the purpose, rather than continue their profitless and uncertain tenure of the municipal contract.

Also in connection with rates comes up naturally the

question of a meter or contract basis. We are leaving out of view now, of course, the case of the large city plants. While on the face of it it would seem reasonable that the current for electric lighting should be measured for sale like any other manufactured product, and not sold by bulk and by guess, there is at bottom a sound reason for the instinctive tendency to continue on the contract basis noticeable in many plants. The reason is, though, not always clearly understood that a mere measurement of the number of units taken to supply a customer for a given time is not a fair measure of the cost, and therefore of the selling price of the units supplied to him. This rests on the fact that all units do not cost alike. Those produced at 6 p.m. for example, the period of maximum load, cost far more than those supplied at 11, in the main and governing item of charge per unit from capital investment. Accordingly the meter measurement of quantity is not a measurement of value or cost, but only an approximation to them upon an erroneous basis. To meet this discrepancy it has been proposed to install two or more meters to measure current taken at heavy and light load periods of the plant, a larger discount being given for the latter. The basis of contract rates which is general throughout Ontario really represents this condition fairly well, the shop and business rates being relatively high, and the residence rates low considering the number of units actually supplied in each case. At the same time it must be recognized that in all cases with the larger, and quite frequently with the smaller plants, especially those supplying a day service, the meter method becomes imperative as being the only method whereby a check can be kept on the consumer for actual lighting supplied. In all cases where meters are used a meter rental should be charged, and a minimum monthly charge for each lamp installed provided for in the contract. Otherwise we frequently find a large part of the lamps connected to a central station, to provide for which a continuous charge on account of capital is going on, returning nothing whatever in the way of earnings for months at a time, and then coming in for the most favored customer treatment of the largest consumer.

Another point in connection with the relationship of the central station and the customer is the basis upon which wiring of consumers' premises is done. The vicious principle of free wiring has been practically frowned out of existence, but one equally mischievous has in some instances taken its place—that the wiring department should be conducted at a handsome profit. The correct principle is, of course, to give the customer for your current the fullest benefit of the present low prices for all interior wiring supplies in order that more and more lamps may be installed and the profits obtained in a legitimate and permanent form.

There are a number of additional matters which might be touched upon in considering this side of our subject, such as the effect of the competition of coal oil, gas and Welsbach burners; the recent governmental regulations and certain desirable extensions of the same, and so on. Not the least important of these, in view of the certain benefits to be derived, is the building up of this Association into a strong and compact organization, able on the one hand to protect the industry in which its members are engaged from the attacks of conflicting interests or of ignorant and harmful legislation, and on the other hand by a frank interchange of experience and opinion to assist in hastening the day when Progress and Profit shall be the happy watchword in all cases describing the conditions of central station operation.

It was intended, had space permitted, to discuss the subject of this paper from the other standpoint which has been mentioned—that of engineering and operation, taking up first the question of selection of apparatus which would give the ideal plant for each set of conditions, and considering in how far deviations from such an ideal installation were responsible for failure to get best results in a given case. Such a consideration of the matter, however inadequate in itself could not fail to bring out points in discussion which, checked by the actual experience of the managers of central stations present, would become of the utmost value.

DETERMINATION OF THE HEATING POWER AND STEAM-PRODUCING VALUE OF COALS FROM A PRELIMINARY EXAMINATION.

By WILLIAM THOMPSON, Montreal West.

THE choice of a subject for a paper to be placed for discussion before an Association composed of gentlemen so eminently fitted for their profession as are the members of the Canadian Electrical Association, becomes a matter of more than ordinary importance.

In choosing my subject I was first guided by the request of your committee that my paper should be along the line of "Chemistry in the Boiler Room," and the fact that the members of this Association are gentlemen who hold responsible positions and in many cases are central station managers, and as such, more than ordinarily interested in subjects pertaining to economical management.

We cannot all of us have such magnificent water powers as we see here and elsewhere throughout the Dominion of Canada, and consequently have to go to the coal pile as our source of power.

A successful station manager takes pride in choosing his generating and distributing apparatus with the greatest possible care, and purchases only that which he considers suitable for his purpose. We all know that there is efficient and inefficient station apparatus, and we all strive to get as far as possible that which we consider will bring us in the greatest return and most efficient service for capital invested. The same principle of getting best returns and most efficient service should, I claim, underlie our system of purchasing our fuel.

It is not my intention to discuss the merits or demerits of any particular variety of coal, but to try to establish a method whereby the heating power, and consequently, the value of any fuel, can readily be determined, and when the knowledge of conditions under which combustion must take place are understood, we shall, in some measure at least, be able to intelligently choose between any number of samples and varieties of coals that are most suited to our purpose.

Undoubtedly the most scientific and correct method of determining the actual heating power of any substance is by the aid of the calorimeter, but when we consider the high cost and delicate manipulation required in an instrument of this kind, we find it is practically debarred from use except by the expert chemist in his laboratory.

Repeated efforts have been made by scientists to construct a formula whereby the actual heating power of coals could be accurately ascertained by computation. Perhaps the most recent and nearest correct formula of this kind that has been given to the public is the formula constructed by Dulong, and more recently by Mahler.

Both these gentlemen based their calculation upon an elementary analysis of the coal under examination, and they both seem to agree upon the fact that the heating powers of coals of a like composition remained constant, and that the heating power of coal changes as the composition changes. They also establish the fact that the heating power of fixed carbon remains constant, as does also that of hydrogen when in combination with the same proportions of oxygen and nitrogen.

Dulong accepts as the heat-producing elements of coal carbon and hydrogen, giving each a constant calorific value, and at the same time determined that the oxygen of the coal renders unavailable for heating purposes one-eighth of its own weight of the hydrogen, and on this basis constructs the following formula:

$$Q = 14,544 C + 62,100 (H - O_8)$$

which for convenience might be written:

$$Q = 14,544 C + 62,100 H - 7,762.50$$

Where Q equals calorific value of fuel,

$$\begin{aligned} 14,544 &= \text{constant heating power of carbon} \\ 62,100 &= \text{ " " " hydrogen} \\ 7,762.5 &= \text{ " neutralizing power of oxygen} \end{aligned}$$

Mahler, at more recent date, and after a series of lengthy experiments, amended Dulong's formula slightly by accepting Berthelet's more recent determination of the heating power of carbon as 14,652 B.T.U., and using

the empirical constant, 5,400, at the same time taking note of the effect of nitrogen as well as that of the oxygen. Mahler's formula then became:

$$Q = 14,652 C + 62,100 H - 5,400 (O + N)$$

Where Q equals calorific value of coal,

$$\begin{aligned} 14,652 &= \text{constant value of carbon} \\ 62,100 &= \text{ " " " hydrogen} \\ 5,400 &= \text{ " neutralizing effect of oxygen, less} \\ &\quad \text{heat formed by formation of nitric acid,} \\ &\quad (N_2 O_5 + H_2 O) \text{ (Note 1.)} \end{aligned}$$

On comparing these formulæ with a long series of actual calorimetric tests made by Mahler, it is surprising how near either of these laws come to the actual theoretical value of the fuel.

To engineers, however, a new difficulty here presents itself, since both of these formulas are based upon an elementary analysis, which is not only difficult to make, but exceedingly liable to give an inaccurate result, unless conducted by a chemist, experienced in this class of work. Consequently we must look for a formula, constructed on the basis of a proximate analysis.

It is for the sake of clearness necessary for me here to explain the difference between an "elementary" and a "proximate" analysis, and also what the term of "fixed carbon" means. An elementary analysis of coal is a definition used when it is understood that the whole of the elements composing the coal are determined and separately enumerated. A proximate analysis determines the coals into four sections, and consists of the determination of moisture, volatile combustible matter, fixed carbon, and ash.

The volatile combustible may consist of several elements, but is chiefly composed of carbon and hydrogen in combination as "hydro-carbons." This carbon is hereafter usually referred to as volatile carbon, and the carbon remaining in the free or solid state is referred to as fixed carbon. For example, the coke from gas works contains fixed carbon plus ash.

M. E. Goutal appreciated this difficulty referred to, and after reviewing the work of Mahler and others, made a number of calorimetric tests, comparing them with a formula of his own construction, and published in *Progressive Age*, Jan. 15, 1897, as follows:

$$Q = 14670 F. C. + A \times \text{volatile matter,}$$

when Q = calorific value of coal.

$$\begin{aligned} 14670 &= \text{constant heating power of fixed carbon,} \\ A &= 23400 \text{ when volatile matter equals from} \\ &\quad 2\% \text{ to } 15\% \text{ of total combustible.} \\ A &= 18000 \text{ when volatile matter equals from} \\ &\quad 15\% \text{ to } 30\% \text{ of total combustible,} \\ A &= 17100 \text{ when volatile matter equals from} \\ &\quad 30\% \text{ to } 35\% \text{ of total combustible,} \\ A &= 16200 \text{ when volatile matter equals from} \\ &\quad 35\% \text{ to } 40\% \text{ of total combustible.} \end{aligned}$$

The result of this formula seems to come as near the actual theoretical value of coals, as anything it has been my privilege to consider, and may at the present time be taken as a useful formula for the calorimetric value from a proximate analysis of coals of an anthracite, semi-bituminous and bituminous nature, but should not be used in cases where the volatile matter exceeds 35% of total combustible, as it gives results altogether too high in samples of extra hydrogeneous or lignitic coals.

Up to this point I have dealt entirely with the estimation of the actual calorimetric value of coals. This, however, does not give us the information we require as engineers. Experience teaches us that there is often a wide difference between the industrial value of bituminous and anthracite coals, owing apparently to the increased percentage of volatile matter in bituminous varieties. A review of Mahler's calorimetric tests shows the interesting fact that the total calorimetric value of coals vary but little, and that a decrease of fixed carbon does not reduce the heating power of the coal in proportion to the increase of volatile combustible matter, while on the other hand repeated tests prove that the industrial value of coals de-

(Note 1) $N_2 O_5 + H_2 O = 2 H N O_3$. The calorific value of 1 lb. nitric acid equals 187.79 B.T.U.

creases almost in the same proportion that volatile combustible increases. The extensive tests of European coals made by Schurer-Kestner in 1868, and afterwards collated by Mons Gruner, gives us most interesting and valuable information on this point.

For industrial purposes Gruner divided these coals into five distinct classes, according to the quantity of fixed carbon contained in the combustible of each.

Class 1: When the total combustible of the coal was composed of 50-60% fixed carbon.

Class 2: 60-68% fixed carbon.

Class 3: 68-74% " "

Class 4: 74-82% " "

Class 5: 82-95% " "

Taking the lowest of each of these classes, he gives the elementary analysis and percentage of total combustible in each class as follows:

TABLE OF INDUSTRIAL VALUE OF COALS,
as per Gruner's classification.

CLASS.	Fixed Carbon, % Total Combustible.	Volatile Carbon % Total Comb.	Hydrogen, % Total Comb.	Oxygen and Nitrogen, % Total Comb.	Actual Value in B. T. U.	Industrial Value in B. T. U.	Industrial Value, % of Actual
5	82.	8.	4.5	5.5	16,560	10,368	62.6
4	74.	14.	5.5	6.5	16,740	10,596	63.3
3	68.	16.	5.0	11.	15,840	9,776	61.
2	60.	20.	8.5	14.2	15,300	8,756	57.2
1	50.	22.	8.5	19.5	14,400	7,716	53.6

We can safely take it as an established fact that the heating power of fixed carbon will remain constant. The same can be said of hydrogen in the absence of oxygen in the combustible, and the heating value of the hydrogen in the combustible will decrease in proportion to the increased percentage of oxygen within the combustible. Both Dulong and Mahler recognize this fact, and construct their formula accordingly. It will be observed that both the calorimetric and industrial value of Gruner's class 4 is higher than class 5, although the percentage of fixed carbon has decreased 8%. The industrial heating value, however, has not increased in proportion to the increase of hydrogen in the fuel, while actual heating value by calorimeter fully accounts for such an increase. Although the difference is but slight in this particular case, it points to a very significant fact, which is more clearly exemplified in the following three samples of coal; that is, that the actual calorific value of coals decreases in nearly the same proportion as the neutralizing effect of the oxygen on the hydrogen increases, and that the industrial heating value of the coals under the boiler decreases as the proportion of volatile carbon increases.

We have this strongly exemplified in our daily practice. It requires but ordinary observation for us to readily see that anthracite coals produce practically no smoke, semi-bituminous coals very little, while bituminous coals produce dense, black clouds of smoke varying in density and volume according to the quantity and composition of the volatile combustible matter in our fuel. An examination of the sooty deposit formed by the condensation of the smoky products proves it to be largely composed of minute particles of carbon which is combustible, proving to us pretty conclusively that the cause of the decrease in industrial heating value is loss of heat from the carbon of our coal, due to the extremely volatile nature of the carbon in combination with hydrogen as hydro-carbons.

It has been said that the industrial value of a coal for steam-making purposes is practically fixed by the percentage of fixed carbon in the fuel. A review and close examination of Gruner's tables of the results of tests on European coals, and verified as being practically correct by similar tests made by Johnston on American coals at a more recent date, shows us we cannot take this method of determination as a permanent basis for calculation with any degree of accuracy. In Gruner's anthracitic class 5, industrial heating value of coal only equals 83.3% of the heating value of the fixed carbon, with Berthelet's determination as a standard.

In semi-bituminous class 4, industrial value equals 97.7% of heating value of fixed carbon; in bituminous

classes 2 and 3, 97.1% and 99.6%—showing us that if we undertake to fix industrial value of coals without reference to volatile combustible matter, we are liable to rate value of anthracite varieties too high.

Bearing in mind these facts relative to the heating value of the volatile combustible, it becomes markedly difficult to construct a formula applicable to a proximate analysis.

It has been established fairly satisfactorily, however, that volatile matter of similar composition will give off like quantities of heat. Mr. Goutal kept this fact prominently before him, as also the fact relating to fixed carbon, and consequently gives in his formula a series of constants for the determination of the heating power of the volatile combustible. While these constants might be improved upon by division into shorter sections, the results are nevertheless near enough the theoretical value for ordinary purposes.

The adoption of the principles underlying Goutal's formula, and multiplying by the average percentage of efficiency of the various classes of coals for industrial steam-making purposes as determined by Schurer-Kestner on European coals and Johnston on American coals, leads me to the belief that a formula constructed as follows will be of especial benefit in enabling engineers to arrive at the steam-making capacity of their coals:

$$Q = 14,652 \text{ f.c.} + A \times \text{volatile matter} \times B,$$

Where Q equals 23,400 when volatile combustible is equal to from 2% to 15% of total combustible,

A equals 20,000 when volatile combustible equals from 15-30% of total combustible,

A equals 17,100 when volatile combustible equals from 30-35% of total combustible,

A equals 16,200 when volatile combustible equals from 35-40% of total combustible.

Where Q equals industrial value of coal for steam-making purposes, and where

B equals .64 when fixed carbon equals 82-90% of total combustible,

B equals .65 when fixed carbon equals 74-82% of total combustible,

B equals .662 when fixed carbon equals 68-74% of total combustible,

B equals .588 when fixed carbon equals 60-68% of total combustible,

B equals .551 when fixed carbon equals 50-60% of total combustible.

In reviewing this formula I may say I was guided in its construction by the fact that the heating value of the volatile combustible is a constantly changing quantity, but remains constant in accordance with its composition of the elements, and that these elements occur in practically fixed proportions, determined by the total volatile combustible matter in the coal.

With this formula and the proximate analysis before us, we are readily enabled to determine, which of two coals are likely to be the most economical and best suited to the conditions under which combustion must take place, and will, I hope, be found useful by my hearers in enabling them to arrive at the real value of any sample of coal placed before them for their examination and opinion.

ECONOMY IN CIRCUITS.

By D. H. KEELEY.

The design of the diagrams presented hereunder is to establish the fact that, without exceeding the weight of copper, or the drop of E. M. F. in current transmission, found in a single parallel system, it is possible to provide for distribution with an equalized pressure at all points.

This diagram (Fig. 1) represents a transformer delivering 52 Volts with a primary resistance of .05 Ohm.

Current is supplied to 17 lamps, each taking normally 1 Ampere, and located in groups equidistantly—two of them at the terminus of the transformer.

The mains are of such size as presents a resistance of .05 Ohm per 1000 feet.

The total drop, it will be seen, is $.85 + .375 + .125 + .125 + .375 = 1.85$ Volts. The difference of potential is 2 per cent. less at the terminal group than it is at the transformer; being, as it figures out according to the drop, $52 - .85 = 51.15$ Volts between A and A1; $52 - 1.60 = 50.40$ Volts between B and B1, and $52 - 1.85 = 50.15$ Volts between C and C1.

This diagram (Fig 2) represents two transformers of half the size and capacity of the one shown in the preceding figure, each delivering 52

Volts with a primary resistance of .1 Ohm. The number of lamps and their locations are the same as before, the mains in this instance, like the transformers, are half the size of those shown in Fig. 1 and present a resistance of .1 Ohm per 1000 feet.

PHILOSOPHY OF FIG. 2.
In a circuit supplied with E. M. F. from more than one source, the current developed at objective points is proportionately contributed to from the several sources of the E. M. F.
Following the above, the amperage of the circuit is halved between the transformers V and VI. To simplify matters, the courses of the currents ordinarily obtaining are indicated by arrows; V heavy and VI

The author's apology, if any is needed, for bringing this matter again to the notice of the members of this Association is that it might perhaps happen that a good thing was being lost sight of because of its not having been presented in a sufficiently clear manner to secure its recognition on a former occasion when it was dealt with under a different title. The circumstance that at the Ottawa Convention a paper was submitted by the author which in subsequent published comments was stated to have explained a demonstrable but somewhat abstruse fact in a new and clear way, will perhaps justify a renewed effort in regard to the present subject.

The importance of providing for an equal distribution is, from the

Fig. 1

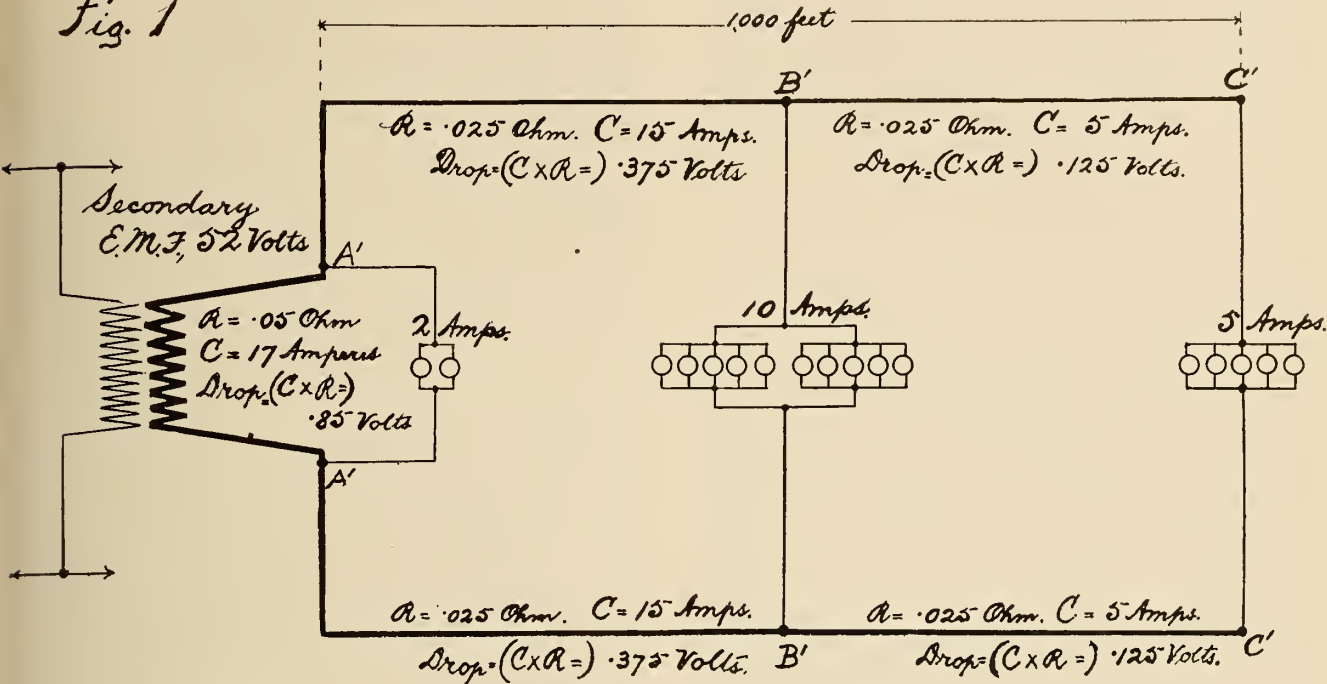
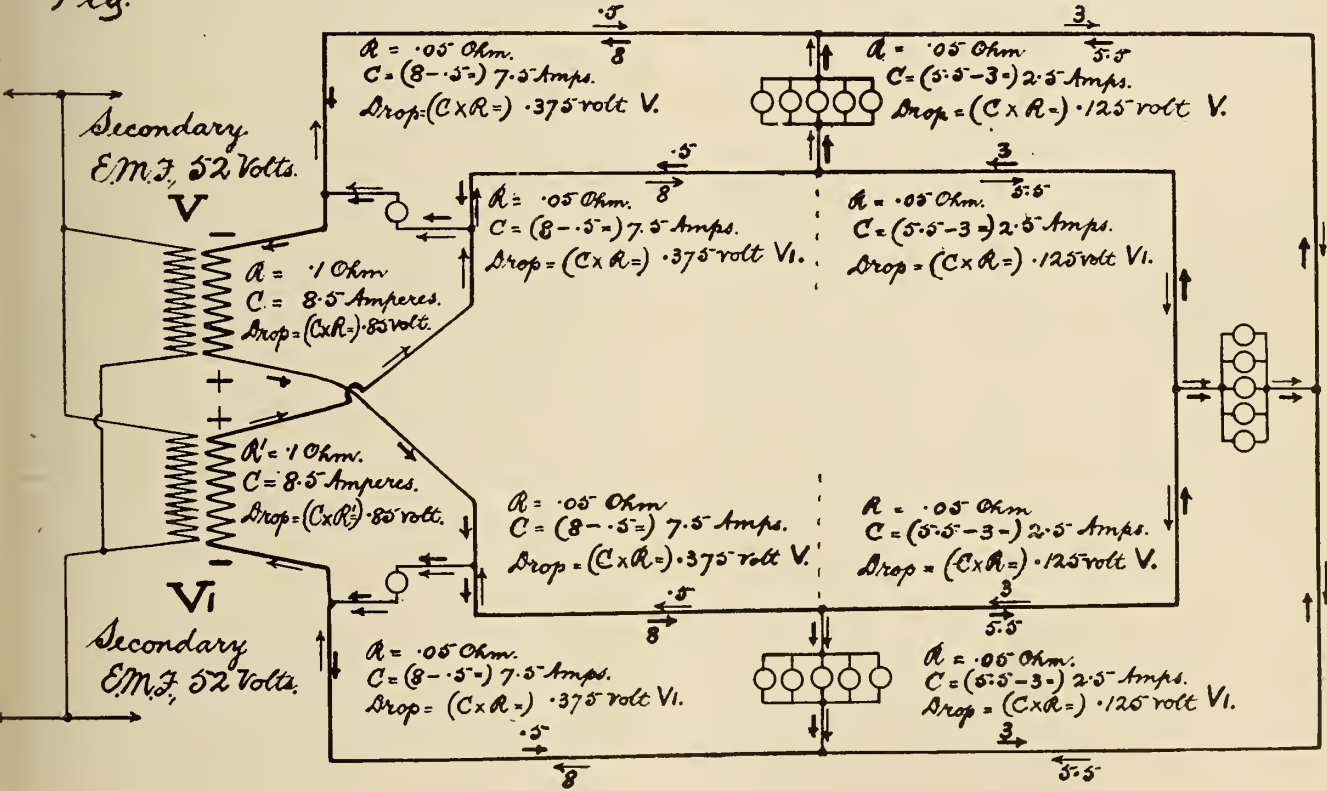


Fig. 2



Distance from sources V VI to terminal group 1,000 feet.
The other groups occur midway.

light, running from + to - in each case. It will be seen that where they are opposed, the difference between the two represents the amperage obtaining. The allotment of absorption is traced accordingly. On the whole the distribution of the applied E. M. F. is the same as if the circuits of V and VI separately ended at the terminal group 5 A. The total drop, it will be seen, is .85 + .375 + .125 + .125 + .375 = 1.85 Volts in V for half the amperage; and the same in VI = in all 1.85 Volts for the 17 amperes—the pressure or potential difference under these changed conditions being the same at all points since the same total drop of 1.85 Volts is found along the mains between the transformers and each of the several groups.

writer's point of view at any rate, secondary to nothing in the electrical field. Perhaps reference may be allowed to an editorial on page 151 of the September, 1895, number of the Canadian ELECTRICAL NEWS in which the question of economical supply is dealt with. The author of that article prefaces the whole with the observation that
"It is of great importance to electric lighting stations that the pressure all over the system should be sensibly the same, and equal at all loads."
We are all, of course, prepared to grant this proposition as a whole—whence it follows, the conditions requisite to the end had in view should be enquired into. In the first place it will be seen the requirement, though taken "altogether" in the above quotation, is of a two-fold

character. The need for equalization of pressure throughout a system of supply is one thing, and the need for a uniform pressure under all loads is another thing. The one hinges on the other, however, and so long as one department remains undeveloped the other cannot be brought to make up for the deficiency.

Now it is the first mentioned feature of this proposition—the need for equalization of pressure throughout a system—that has been dealt with in the present paper. In the other department—covering the need for a uniform pressure under all loads—we are presented with a problem that so far seems to have been grappled with from behind the dynamo or by the introduction of boosting devices effecting changes of pressure in the mains. As it happens, however, that these changes are made in the circuit as a whole without any particular reference to individual transformer (or lamp group) requirements, it follows that near-by points are given an excessive pressure when the increased demand arises farther off; so that at any time in their operation these methods only operate to maintain a uniform pressure at a given point of the system, and a general uniformity of pressure cannot be obtained by these means alone. The main thing, then, is to secure equal distribution; that being provided, the means already found for regulating the pressure will fall handily into line; and the whole object aimed at will be as nearly attained as may be, pending the evolution of something less clumsy and perhaps automatic, regulating the output of the dynamo.

In conclusion, the point aimed at will bear a little further exposition. In a system of circuits arranged to supply an equal potential difference at all points, it will be found the drop between the source of E. M. F. and the points of consumption is the same in every instance.

As regards the leads then, the absorption of the transmitted E. M. F. amounts to the same total quantity, no matter from what point it is calculated. Hence, when an increased demand arises at any point, the absorption in the mains becomes correspondingly increased in all parts; and when the initial pressure is increased it similarly takes to all parts, thus evenly compensating for the increased absorption and presenting no increase of P. D. at any one point more than another, and in no case higher than may be predetermined or desired.

Moreover, in any such system of circuits a lamp (if the supply is a direct one), or a small transformer operating a lamp (if the supply is in that way conveyed) may be located in the supply station, and it will burn with the same current at the same pressure as any other lamp in the system though this latter extends for miles.

And this it seems can be realized, as demonstrated in the diagrams, without exceeding the weight of copper that is now used in the two-wire or simple parallel system, and at the same time without involving any further drop of the applied voltage than obtains in that two-wire system.

One word more. When we will have arrived at that stage where the pressure in the mains can be kept at something in excess of the demand, while at the points of consumption only so much current is drawn off as there is a demand for, we will have attained perfection. The whole thing will then be automatic. But, in such a system it is obvious an arrangement of circuits operating as described in this paper will be altogether indispensable, so we will have now made much of an advance towards that era.

THE COMMERCIAL ASPECT OF ELECTRIC RAILWAYS.

By C. E. A. CARR.

THE subject of my paper "The Commercial Aspect of Electric Railways" is a question that has engaged the thought of the ablest men for years, and in presenting this paper, I do not presume to know more than my fellow creatures, nor to have discovered any special facts that give a satisfactory answer, but merely give you a few chapters from my own experience and observation.

This is not the time nor the place to discuss the best method for the collection of fares, whether to use a rigid or flexible bond, or whether a single or double truck is best, although these details require a great deal of study, and bear a close relation to the answer to my subject.

Electric railways on this Continent are usually built by a company authorized to do so by special Provincial or State legislation, and the opposition so generally met with in obtaining these special powers, is but a pleasant (?) introduction to the later difficulties to be met with in securing from the various City and County Councils the rights to lay down rails and run the cars. Having secured a charter and obtained agreements from these various Councils, the real work of railroading begins, and as to what are the best methods of construction, equipment, and operation to make it a success, will be the leading thought of this paper.

Track construction is a subject that has been thoroughly discussed from time to time, and as so many Engineers differ as to the best methods, I can only express my opinion as to what forms are best suited under certain conditions. For an electric road in a town or city street, or wherever pavements of a permanent character are used, the girder rail seems to be the only one suitable. The depth of the rail should be not less than 7 in. and should weigh from 70 to 90 pounds to the yard. What the exact weight of the rail should be, would depend upon the frequency of the service required, and the weight of the rolling stock to be used. In a macadam or unpaved roadway, a T rail of 65 pounds to the yard is all that is necessary. While it may be better, under certain conditions to have rails laid in concrete with a permanent pavement, my experience has been that cars rattle and jar a great deal more than when running over a road-bed of less rigidity. In all paved streets, rails should be firmly spiked on oak ties 5 in. x 7 in. x 7 feet, spaced 2 feet apart. The grade should first be properly levelled, and the whole surface covered with good coarse gravel 6 in. in depth. Fish plates or angle bars 3 feet long, with not less than 6 bolts at each rail joint, should be properly fitted and bolted. Soft copper bonds of sufficient size to carry the maximum return current from any distant part of the line to the power house, should be properly attached at each joint.

Many improvements have been made in overhead line materials during the last couple of years, so that to-day there are several manufacturers of very satisfactory supplies.

The trolley should be carried with a straight line hanger thoroughly

insulated and attached to a flexible bracket or span wire. A sufficient number of feeder lines should be used to maintain the voltage under a maximum load, and section switches, emergency breakers and lightning arresters should be placed at frequent intervals, and where a number of lines constitute one system, trolley brakes with each feeder section.

The rolling stock should be the best obtainable, and for city traffic, mounted on single truck with wheel base not more than 7' 6". Seats should be fixed crosswise of the car, and the doors and aisle so arranged as to permit of easy and speedy exit. For a high speed suburban road, a car 40' long mounted on double truck, is more desirable, but as so many companies, operating city lines, make long extensions to some suburban town or pleasure park, the city cars are usually called upon to do service. All passenger cars should be well lighted, fitted with signal bells, curtains, and properly heated during the winter season. Keep the cars clean inside and out, and upon the first appearance of drowsiness, have them overhauled, repainted and varnished. The appearance of a car is next in importance to the appearance of employees, and very often indicates the prosperity or otherwise of a railway, as the ever exacting public is not slow to give its verdict.

The power house of an electric railway, should, like the cars, be the best obtainable. It should be built near a railroad track, so that coal can be cheaply delivered, and it is very desirable that the site selected should be near a good water supply, so that condensing engines may be used. If these conditions can be had near the centre of distribution a very great saving can be effected in the cost of copper feeders. The building should be a substantial structure of brick or stone, well lighted and fireproof. Direct connected multipolar generators, with slow speed compound condensing engines, will give best results, where a moderately steady load is maintained. Where few cars are run, and the fluctuation in load varies from three to four hundred per cent. a high speed engine would give better service, as it responds more readily to the varied conditions.

In Canada, where soft coal is used for fuel, the high freight and duty rates make it essential to have boilers of the highest efficiency, without much regard to their first cost. For this same reason, the boiler room should be fitted with fuel saving appliances, such as an economizer, heater, stoker, automatic damper, regulators, etc., etc.

For an electric railway to be a commercial success depends not only upon the economy and efficiency of its power house, and of the roadway upon which to operate the cars, but "How to make it a Success" is the query that taxes the brain of General Managers and Superintendents throughout the country. How to increase the receipts, without materially increasing the operating expense, are the questions the Directors ask at every meeting.

A certain degree of revenue is the reward of all street railways that run cars up and down the thickly populated streets of any of our larger cities, but is it the success, commercially, it might be? There is an old story told of a toad, that stood on the bank of a brook, with its mouth wide open, waiting contentedly for flies to come his way. It seems unnecessary to say that the toad died of hunger.

The attitude of many electric railways to-day, is not unlike the unfortunate toad, and while life may be sustained months, perhaps years, death, in the form of the receiver, comes too often.

It is not enough that we carry our regular customers. These come to us anyway, and it is to these that we look for a guarantee of our operating expense. The profit or success of the railway lies in the margin of how many we can induce to become patrons, and thereby increase the regular revenue. This may be accomplished by various means. The railway company, like any other business concern, has goods to sell, in the way of rides, and no doubt there are times in the day when the manager feels that he is overstocked, and is inclined to put on "Bargain Matinees" to get a full car. He should advertise and let the public know there is an electric railway in town; that its business is to carry people from place to place comfortably and quickly, and that they can't afford to walk; that the time saved in riding will more than pay the fare. There are various ways in which to do this, and methods may be adopted so that the cost is very slight.

One very good way is to issue annually a handsomely illustrated booklet, which contains cuts of all the interesting points touched by the cars, briefly telling how to get there. The different firms supplying the company with materials will advertise for the asking, and the cost to the company is practically nil. This style of advertising is particularly valuable to strangers and tourists. The railway company in London issued just such a little booklet as I mention, about a year ago, and it was a daily occurrence to see a group of strangers taking a ride around the Belt Line with book in hand, pointing out the various public buildings, parks and squares, as the car went along.

A specially illuminated car for trolley parties is a profitable source of revenue, and the effect of the colored lights along the line, as the car passes, is very pleasing. It is a good way to advertise, and tends to popularize the service. Many electric railway companies establish parks at the end of one or more of their lines, and provide amusements in the way of band concerts, etc. This brings considerable increased revenue, at a time of the day when cars would otherwise be running light. To what extent a railway company should provide attractions for its patrons, must depend largely upon local conditions. Some companies claim to have profited by this departure, while others have an adverse experience. It is more desirable to have the amusements provided by some one who thoroughly understands it, the company making certain concessions in the way of issuing coupon tickets for admission. In this way, the railway runs no risk and profits pro rata on all increased business.

The selection of employees has more to do with the success of an electric railway than anything else. The idea that anyone can run a street car, has, in many cases, resulted in the employment of incompetent, careless and ignorant men who, through these qualities, have brought the railway into public disfavor. Conductors, motormen, inspectors and shopmen have the power to earn or lose money; make the railway popular or odious with the public; keep claims for damages at a minimum or make them a burden, and very often their selection does not receive the care that is exercised in the purchase of ordinary supplies. Every employee should be considered an agent of the company, and should not only be sober and intelligent, but have good judgment and a

cheerful disposition. Loyalty to the company he serves, should be his first motto.

With the whole army of employees, loyal, faithful and devoted to their duty, gross earnings will steadily increase and operating expenses be at a minimum, and the stockholders would no longer need to ask if the road was a success.

The growing demand of the public for better accommodation and luxury in the matter of travel and speed, must be met by giving them better cars, more comfortably furnished and more expensively fitted than heretofore. By supplying these demands, the company will add largely to its revenue.

WATER-DRIVEN PLANTS.

By JOHN MURPHY.

THE subject matter of this paper is one particularly suited to the occasion of a convention of members of the Canadian Electrical Association held within a stone's throw of America's greatest cataract, because the operation of water-driven lighting and power plants cannot be even thought of without this mighty force of nature looming up and overshadowing everything else in the lines of mechanical and electrical engineering that have been heretofore attempted.

Remembering what had been done at Niagara towards developing her unrivalled power, it was surely no wonder that the task of dealing with such a subject as the operation of water-driven lighting and power plants was undertaken with a great deal of temerity.

The writer desires it to be remembered that the various water power plants with which he has been connected have been made up of units never exceeding 500 h. p. in capacity, and further, that the head of water was in every case, within his knowledge, between fourteen and twenty-two feet. These facts are mentioned at the outset so that statements made later on will not mislead.

As close regulation is the most important point in the operation of any electrical plant, I will endeavor to show how this can be accomplished best in a water driven plant, and, as so much depends on the manner of installation, I will dwell for a moment on the importance and method of properly equipping the water wheel gate. I take it for granted that the water wheel itself was placed in position by a competent engineer, due provision made to cope with low water, anchor ice and the many other troubles inherent in the use of water power. This having been done the gate and all its connections, from the water wheel to the hand wheel in the dynamo room, should be so constructed as to move quickly, positively and easily. These parts should, as I have just remarked, move quickly, positively and easily, so that the instant the regulator is actuated by a variation in speed the water wheel will receive its greater or lesser supply of water and thus be enabled to maintain a constant speed.

If the water wheel gate works in the manner described, any one of a number of regulators now on the market will keep the speed variations, and consequent potential variations, within very narrow bounds, and the question of keeping a constant load on the water wheel, with the attendant objectionable operating devices of this system will not need to be considered.

An arc plant with its automatic current controllers, driven by a water wheel equipped as indicated above, will run for an indefinite period with little or no attention,* but incandescent lighting and power machinery require somewhat more supervision.

Although one of the chief inducements which manufacturers hold out to intending operators of electrical plants is, that the multiphase system permits both light and power to be obtained from the same generator, yet I hold it is a mistake to attempt to supply power from a lighting circuit except in very small units. Incandescent light and power should, I feel certain, never be run from the same water wheel. One of the greatest recommendations for the glow-lamp as an illuminant is its steadiness, but this quality is almost unknown when motors which are frequently started and stopped are run on the same circuit.

The separately driven exciter is a great boon to water power users whose loads are subject to great variations. Its many advantages are so apparent that it seems unnecessary for me to do more than merely mention it in passing. Another arrangement, the utility of which speaks for itself, is the automatic field controller, which strengthens or weakens the generator field circuit according as the potential on the line falls or rises.

An incandescent lighting plant requires a certain amount of hand regulation, although the apparatus just referred to is useful, within certain limits. All hand regulation necessary on a lighting circuit should be done, figuratively speaking, as far away from the lamp as possible; in other words, it is the field circuit of the exciter that should be varied when it is necessary to change the potential on the line. The exciter field rheostat should be of large range and divided into a great many sections, so that the movement of the rheostat-arm from one point to another would cause such a slight change in field current as to make a scarcely perceptible difference in the brilliancy of the lamps.

Where large generators are used and many circuits are run the use of individual circuit regulators becomes imperative. But, I find I am digressing from the theme, and am already well into the consideration of the switchboard, a point I did not intend to raise at all.

Before placing my convictions as to the operation of water driven power and lighting plants before you for vivisection, I desire to mention two little pieces of mechanism which will not only tend to improve a service but may hinder the occurrence of a "run away" with its disastrous results. The first device to which I desire to direct your attention is an automatic speed indicator and alarm, which, as its name implies, always points out the speed at which the machinery is running, and also loudly rings a bell or gong at every change of speed, no matter how slight it may be. The other machine referred to closes the water wheel gate the instant the speed rises above a predetermined point. It consists chiefly in a pair of friction pulleys mounted in a frame. One of the friction pulleys is continuously driven from the machinery to be controlled, and the other is connected to the gate-closing apparatus. These friction pulleys are normally placed apart and are brought into contact by a weight or spring, which is released by a lever attached to a pair of governor balls. The instant the speed rises a certain percentage above the normal, the governor balls move the lever, and the weight or

spring being released the frictions are pulled together and the gate is immediately closed down before any damage can be done.

It would hardly seem correct to leave the subject of the operation of water power plants without at least mentioning that lane of water power users—anchor ice. If wheels are favorably situated, that is if they are supplied from a large pond in which there is little or no current and if there is an overflow or by-wash into which most of the floating ice can be diverted, by extreme watchfulness a complete shut-down can be prevented. But, if the wheels have no still pond from which to draw their water supply it is prudent to resort to the auxiliary steam plant as soon as there is the least suspicion of the approach of anchor ice.

I have striven to deal in a general and concise manner with the operation of water driven lighting and power plants. So much could be said about each of the various parts of such plants from the wheel-pit to the cupola that I have, for the sake of brevity, refrained from particularizing except where it seemed absolutely necessary so to do. Should even a single user of water power derive a benefit from any of my remarks, I shall consider myself amply repaid for the labor expended in placing upon paper my very unassuming sentiments.

THE STEAM END OF AN ELECTRIC PLANT.

By A. M. WICKENS.

IN VIEW of the fact that we are holding this convention at the place where is situated the greatest water power in the world, where recent developments have done so much to advance the usefulness of large water powers, and the transmission of electric currents to long distances, as well as the establishing of large electrically-driven factories situated near the developed power, it seems almost an anomaly to speak of steam power. The position of a great number of the Canadian water powers is so far removed from commercial and manufacturing centres, that even with the present and prospective advance in the transmission of electricity, a very great number of our electrical plants must still rely on steam and the steam engine as their motive power. This being the case, it behooves us to enquire more particularly into the working, the efficiency and cost of operating an electrical plant by steam.

Our friends, the manufacturers of dynamos, tell us with some considerable pride of the rapid advancement in this class of machinery, and claim to be able to make a generator that has an efficiency of 95%. This statement, I believe, is reasonably borne out, and leaves us in the position that if we expect any further economy we must look to the prime movers or engines and boilers for it, unless our electrical engineers can approach the glow-worm in efficiency, which makes its light with about one three-hundredth part of the force used in our ordinary incandescent lighting plants—or should the electrical engineer reach, in the near future, vacuum illumination, without incandescence, we should have a light at $\frac{1}{10}$ or less of the present cost for power. But during the time these inventions are being perfected we must do the best we can with our steam engine and boiler as prime movers in hundreds of our electrical plants. Space and time will not permit us to go into a history of the evolution of the steam engine, neither can we go into the actual merits of the different makes of steam engines. There are many engines running to-day that are running with an efficiency of from 70 to 80%; notwithstanding this the waste between the coal pile and the dynamo pulley reaches $\frac{1}{10}$ of the total heat in the coal. Our steam engine is only a heat engine, and is subject to many losses—in fact, in some of the old engines, with large cylinders and slow piston-speeds, the water consumption was as high as 60 lbs per hour per H. P., while to-day, with our higher boiler pressures and faster piston-speeds, with early cut-offs, we reduce that to 12½ lbs. water per H. P. per hour.

The heavy cylinder losses in the old, slow-running engines caused engineers, as far back as 1825 to 1836, to look for higher pressures, and at the latter date Mr. Perkins in London succeeded in using pressures from 500 to 1500 lbs. per sq. in. This very high pressure at that time was only expanded eight-fold, and even under such adverse circumstances gave a H. P. for about 12 lbs. of water per H. P. per hour. Some of the earlier engines gave 5,000,000 foot lbs. per hundred lbs. of coal. Watt built engines that gave a duty of 100,000,000 to 120,000,000 foot lbs., while some of the modern compounds give from 130,000,000 to 150,000,000 foot lbs., thus showing a reduction in fuel from 12 lbs. per indicated H. P. to 1½ lbs. or even 1¼ lbs. for each H. P. The ratios of expansion have also materially increased—from twofold to twenty-fold—and thermo-dynamic considerations say we should still increase the number of expansions. The engineer in striving after too many expansions may find himself over-weighted with engine friction and internal wastes by using too many cylinders to accomplish his object. A recent engine built at Sibley College, with four cylinders, operated under 500 lbs. pressure, at high speed, is claimed to have developed a H. P. with less than 10 lbs. water per H. P. per hour. It is, of course, fitted with re-heaters between each of the cylinders, and is carefully covered to prevent loss of heat by radiation.

Our greatest loss is the loss of the latent heat in the steam discharged into the atmosphere or condenser, and as far as known is unavoidable. The combustible in one pound of coal will contain about 14,500 heat units. A well-designed and properly set boiler will deliver to the engine for work in the cylinder 70%, or 10,000 heat units for each pound of coal burned. If this was all utilized we would have a H. P. for 0.26 of a pound of coal per hour. But by the highest engine efficiency yet attained we use 1½ lbs. coal per H. P. hour, or only about 17% of the energy delivered by the boiler is converted into mechanical work. It is safe to say the average engine of the best makers, running in the electrical plants in Canada, requires at least 3½ lbs. coal per H. P.

hour, thus discharging into the atmosphere over 90% of the energy supplied by the boiler. There are cases where the coal consumption is even higher than 9 lbs. per H.P. per hour, but these are either the result of avarice or ignorance—avarice in men who are imbued with the idea that a cheap boiler and engine is an economical machine and that it can be operated by cheap labour; and ignorance on the part of men who claim to be engineers, but who are only dabblers in mechanics, slick salesmen or merely stoppers and starters in the engine room.

The evaporation of water per lb. of coal varies to an alarming extent, and goes from 5 or 6 lbs. to 10 or 11 lbs. water per lb. of coal. Among the various causes for this, is the different calorific values of the coal itself, the difference in the construction of the boilers, the numerous different kinds of setting, and most of all the kind of a fireman you have shovelling the coal into the furnace. The average evaporation with ordinary return tubular boilers does not exceed 6 lbs. water per lb. of coal burned. If the boiler is well set and well fired an evaporation of 8 lbs. water can be obtained. This supplied to an engine giving a H.P. for $3\frac{1}{2}$ lbs. coal per H.P. hour, would represent a water consumption, as per indicated card, of 28 lbs. water per H.P., and is called good practice. If we increase the evaporative capacity of the boiler and evaporate 9 or 10 lbs. water, we are making a great saving. Again, if we increase the efficiency of the engine until we only consume 15 lbs. of water, we have also made a saving that will look well at the end of the year's accounts. Even with our best arrangements our heat losses are great, and engineers are looking for further improvements.

Among the most recent is the superheating of the steam, a plan that was very fully tried and discarded about 30 years ago. The practical difficulties supposed to be prohibitory to the use of super-heated steam, seem to have been overcome, later experience having shown that by purifying feed water the parts of the super-heater do not show signs of scaling, burning or other injury, and with the improved lubricating oils no further difficulty need arise in the pistons or wearing parts of the cylinders. In a recent paper on super-heated steam engine trials, read before the British Institution of Civil Engineers, by Professor Wm. Ripper, M. Inst. C. E., the author says: "The heat expended in super-heating reduced the amount of heat employed in evaporation of water; but the heat so diverted for the purpose of super-heating, was shown to be productive of a considerable gain in thermal efficiency. Thus an expenditure of 5, 10 and 15% of the furnace heat to super-heat gave a net gain of 12, 28 and 70% respectively of the work done for the heat supplied. When the load on the engine was fairly constant very little regulation of the super-heat was necessary, and the temperature of the superheated steam in the coils remained remarkably steady. When the steam was superheated it was in a more stable condition than without super-heat, and if the steam contained sufficient excess heat, the steam in the cylinder could be rendered dry at cut-off and release, thus removing all water in the cylinder, which is the great loss in the cylinder, also reducing the amount of heat exchange between the steam and the cylinder walls. One example shown was with steam at 120 lbs. pressure per sq. in. superheated to 674 degrees Fah., which in use reduced the steam consumption from 38.5 lbs. to 17.05 lbs. per indicated H.P. per hour. The rate of decrease of steam consumption being approximately uniform within certain limits, the best results were obtained when the steam was supplied at about 650 deg. Fah. at the engine. It is also important to cover cylinders and pipes with good non-conducting material to maintain the high temperature as long as possible."

This shows that engineers are looking for higher temperatures without increase of pressure as one means of improvement and economy. Thermo-dynamics tell us, and the whole trend of modern steam engineering convinces us, that higher temperatures and pressures, increased ratios of expansion and higher piston speeds are all conducive to a greater economy in the use of steam.

For the larger electrical plants, that is those of one or two thousand horse power—we need hardly say very much, because they generally have some one at their head with sufficient engineering ability to make a fairly economical running plant—that is, if the board of directors will allow them to spend enough money for this purpose. These larger plants are usually in our cities, where ground is valuable, and oftentimes water for condensing purposes is not obtainable. To these plants a way is open for cheapening the cost of operation by adopting a water-cooling tower and circulating pump, the cost and operation of which was so carefully gone into last year by Mr. E. J. Philip in his paper on that subject.

The smaller stations—and their number is nine-tenths of all our electric plants—are in a somewhat different position; in fact, many of them are paying a very small return for the money invested. The problem for many of them is: What can I do to make ends meet? In many cases this is not surprising to the engineer. The plant perhaps consists of one, two, or more engines, bought more with a view to saving first cost than anything else. The boilers are also the same—perhaps overrated as to capacity; the setting of each is poor, and their relative positions are bad; chimney drafts not good; boiler tops and domes uncovered; steam pipes bare, feed water pipes bare, and a few small leaks here and there of steam and water—the whole topped off with an engineer (?) at the munificent salary of \$1.00 to \$1.25 per day of 12 or 13 hours. No part of this plant is clean, and in engineering cleanliness is next to godliness; the man has neither time nor inclination for such work. The boilers are dirty, too, for want of cleaning out and the proper appliances to do it with.

Let us see what some of these things mean in coal. In the first place, a badly set boiler with a few small cracks here and there will not evaporate more than 4 or 5 lbs. of water with 1 lb. of coal,

while a well set and well fired boiler of the same kind will most likely reach 7 or 9 lbs. water with 1 lb. coal. This is a loss of from 25 to 35%. The main steam pipe is uncovered. What does that mean in coal? We will suppose the steam pipe is four inches diameter and 40 feet from boiler to stop valve at engine. Each square foot of this pipe will condense $\frac{1}{2}$ lb. of steam per hour, and each foot in length represents one square foot of surface; we have 20 lbs. steam per hour lost. An all-night run will average 11 hours per night, and the steam lost per year is 80,300 lbs., and, with your poor evaporation, 8 to 10 tons of coal per year. If your steam pipe is large and longer than the above, it will cost correspondingly more. If your pump pipes and heater are bare, the loss from this will be from 30 to 40 degrees to your feed water, which means respectively 3 and 4% of fuel. If you are burning $2\frac{1}{2}$ tons coal per day, this means a ton of coal every 10 days. If the domes and boiler top are uncovered, and the boiler is 6' x 14', you will have 90 sq. ft. exposed, and the loss in coal will be double the loss in your steam pipe—say 19 tons coal per year. If the boiler is scaled inside, the conducting power of scale is very low—being, according to D. Rogers, as 1 is to 37 $\frac{1}{2}$. Nystrom tells us that with clean plates $\frac{1}{4}$ -inch thick steam at 75 lbs. pressure can be produced by heating the plates to about 325 degrees, while if $\frac{1}{2}$ -inch scale intervenes, it will be necessary to heat the plates up to 700 degrees—very nearly a low red heat—and a heat at which the iron becomes granular and brittle; a scale of $\frac{1}{16}$ of an inch thick requires 15% of fuel extra.

The troublesome substances in our feed waters are earth, clay, bicarbonates of lime, sulphate of lime, chloride sulphate of magnesium, carbonate of soda magnesia, dissolved carbonic acid and oxygen, iron and acid. These substances can all be treated in such a way that they will be removable. Some require caustic soda and lime, some need barium, others require chloride; all organic matter needs alum or fessic, and should be filtered.

If boilers are kept clean and well fired, the saving in coal amply pays for the cost, leaving a good margin of profit for the proprietor. A small leak through the exhaust valve of the engine soon makes itself apparent in the coal pile. Badly set engine valves are often prolific sources of loss; I have corrected engine valves and made a saving in coal of 12%.

To the owners of the smaller plants I would say, make the best of what you have got; stop all the small leaks and losses; get more of the heat in the coal into the engine, and keep the engine right. If you are burning 1,000 tons of coal per year you can save at least 25%, or 250 tons, by keeping everything right; 250 tons of coal means in many places \$1,000. This in many places can be saved by expending 40 or 50% of it the first year—after that it should all be saved. Get a thoroughly well posted engineer to look over your plant and advise you as to where savings can be made; don't go to a civil engineer or to an electrical engineer, consult a mechanical engineer. If you had a bad fever you would not go to a dentist for treatment. Go to the right kind of an engineer, pay him for his advice and follow it, and make an ordinary electric plant a reasonably good paying investment.

DAY LOADS FOR CENTRAL STATIONS, AND HOW TO INCREASE THEM.

By J. A. KAMMERER.

AT no period since the inception of the electric lighting industry have central station managers and operators taken such a deep interest in all the details of their plants.

As an evidence of this, there is no more encouraging sign, than the constant desire by operators for the most complete information concerning, and a fuller understanding of, the apparatus they are using.

This interest is not exhausted by enquiring and becoming familiar with the different points in the apparatus they are using, but is extended to the underlying principles of the relation between the cost of producing electric current, and the compensation received therefrom.

Study of this relation is being logically and systematically undertaken, and is more and more made a basis upon which the earning capacity of the plant is calculated.

The result of this movement is making itself felt in no small measure by those pioneers in electric lighting work, who are now profiting by their experience and reaping the first benefits of the departure from old lines of conducting electric lighting business.

The ruinous effects of many of these old business methods are now largely recognized by central station managers, and their energies are being directed to retrieve what has been lost in the past in this respect. They are re-arranging their plants, or are completely reconstructing the same, with more efficient apparatus. One of the first questions asked by a pioneer central station manager, when he desires to purchase a new piece of apparatus is, "what is its efficiency?" not "what is the price?" He knows that the true value of everything in connection with central station work, in fact, with the entire plant is "efficiency" or cost of operation, and "quality" or cost of repairs. His whole work must be to make the plant more efficient, and less expensive to operate and repair, and hence more remunerative in order to pay a dividend on the invested capital. This is being brought about in part by the reconstruction and rearrangement of the central stations, and is the first and essential step, but the effort does not stop at this work.

Other means of procuring remunerative return for energy expended and capital invested must be and is being sought. Increase of rates cannot be looked for, therefore additional income at present, or at even less rates, must be obtained. Such additional revenue must be obtained from increased and prolonged use of current, to obtain which, means of having current used for other

purposes than illumination must be found, and consequently use in the day-time or a "day load," as it is called, must be secured.

It is claimed, and it must be admitted with some truth, that because the particular business of electric lighting companies is night-work, they should not look for a day load, any more than a woollen mill or any other kindred industry should look for a night load. This at first blush looks reasonable, but were the margins on the woollen mills or other commodities as small as they are in most of our cities and towns on electric lighting, the woollen mill would either have to close up, or make its plant investment work day and night to make ends meet.

Then here is where the dividing line can be clearly drawn. The one industry or industries can exist because the margin of profit on their product is sufficiently large to pay a reasonable return on the capital invested by operating their plant at its maximum output only 10 or 12 hours out of 24. On the other hand, a central station operating a lighting load only is handicapped, because it cannot procure a maximum load for even 2 hours out of the 24. Its maximum investment is therefore only exerting its full earning power for less than 2 hours instead of 10 or 12 hours daily.

The aim then must be to place electric lighting central station business on the same footing as any other industry, by making the plant investment work a greater number of earning hours in each twenty-four. To accomplish this there must be, in addition to its regular work, a day load for the lighting plant.

The operation of a day service for electric lighting prevails only in a few of our larger cities. This is usually had, however, by a separate service, necessitating the investment in, and operation of two systems, one for lighting and one for power—which is too expensive for small central stations, and still leaves the question of the maximum investment and maximum earning hours unsolved, as the lighting system will still have only a very small day load, as against whatever a separate power service might earn. The difficulty must therefore be met by making as small an investment as possible in what will take care of a combined light and power load.

The multi-phase alternating current system, by which motor power can be provided as well as arc and incandescent lights, meets the situation in this respect.

With existing single phase alternating current lighting plants, the change can be made without any considerable expense other than in the generator, as everything is already in place for the lighting, and the only expense for motor service is a small increase from time to time on capital account, as demand is made for power.

No capital invested need lie idle waiting for business to turn up, as there can always be a return in sight on any investment before the extension is made. This holds good to a greater degree where a new plant is being installed, as the outlay is proportionately less, owing to the fact that arc and incandescent lights as well as power may be served from the same circuits and generator. In this manner the central station is in a position to cater for a day load.

The cost of supplying a day load, in comparison with a night load only, is very much less, as the fuel necessary to start up the cooled boiler, and that for maintaining banked fires during the day, would be saved. The depreciation on apparatus would be slightly greater, but the interest on everything and the depreciation on lines, poles, etc., is the same as if it were only an all-night run, thus making the additional expenses for the day run much less than the night run alone.

The central station operator is then in a position to give lighting service all day long, and add to his lighting business those consumers who have been heretofore objecting to using incandescent light, because of the necessity of maintaining coal oil or gas lamp lighting in dark places in stores, cellars, etc., during the day.

Where there is an electric light day service such consumers cannot offer the excuse now made that risk from fire is as great with a few gas jets or coal oil lamps, as though they were to light throughout with an open flame light, and that the matter of the small additional cost of incandescent light is not their reason for not using it. As the central station can remuneratively furnish incandescent light throughout the 24 hours this objection is removed, and a large amount of profitable business, which before could not be handled, can now be secured.

In dry goods stores where delicate fabrics are being handled, and where an open flame light creates risk from fire, the objection that different delicate colors cannot be distinguished by artificial light is removed, as an arc lamp can be placed in these stores operating from the alternating current system, which gives a near approach to solar light, and makes it an object for the storekeeper to install this light, as by it delicate colors are easily distinguishable.

By an all-day service there would be removed another hindrance to extended use of incandescent light. The objection is frequently and fairly offered that if incandescent light is only available during the hours of atmospheric darkness, or from dusk to daylight, it is necessary to have in reserve and ready for use at all times another source of artificial light in case of very dark days; and the conclusion is reached and acted upon, that as it is necessary to have a number of these lamps on hand, which must be kept ready for use at any moment, electric light being available during only a portion of the 24 hours, there is no reason why it should be used at all, although if available at all times it would be used because much preferred for so very many reasons.

While the additional revenue secured from these lights may not be sufficient to pay the extra expense of running a day service, yet it must be borne in mind that it is not alone the day load the central station is getting, but also an additional night load consequent on customers being provided with light for the full 24 hours.

This must be taken into consideration as making the night-load more remunerative at a very small added cost.

These briefly are the points from a lighting standpoint that will commend themselves, and, no doubt, are familiar to most of the central station operators.

Aside from all this is the strictly speaking day load, which consists of the motor load, and which it is possible to secure with the multi-phase alternating current system. As a rule there is the butcher with his meat chopping machine, the baker with his dough-mixer, the newspaper with its printing press, the foundry with its line of shafting to drive, and the planing mill with its machinery to be kept going throughout the day, in every town, while other and larger industries will be attracted to a town in which a day power service may be obtained. These different industries all using power during the day-time tend to create a steady load line, which is especially desirable, as it increases the number of hours in which the investment is exercising its earning power, and helping to increase and secure the maximum load line throughout the 24 hours.

ACCUMULATORS—THEIR APPLICATION TO CENTRAL STATION LIGHTING AND POWER.

By W. A. JOHNSON.

To those who have given attention to the use of accumulators and have posted themselves sufficiently to have even a fair idea of their adaptability, it seems incomprehensible why the central station owners in Canada have so long delayed availing themselves of their advantages.

Considerable misconception seems to exist in reference to the cost of installing a storage battery. Like all good things having value accumulators are not given away, and the station manager who is waiting for them to get cheaper is letting one-third of the earning power of his station go to waste.

Local conditions, of course, determine the capacity and consequent cost of battery, but in general terms the cost may be stated to be less in most cases than the cost of generating plant.

When it is desirable to increase the capacity of a station, it means besides new dynamos, increase in engines, boilers and all steam appliances, and usually alterations in the building, and while the output of the station is increased the general efficiency remains about the same, and often times the running expenses of a moderate sized station is greater per h. p. output, owing to the increase in the working staff.

On the contrary, to increase the capacity of a station with accumulators requires, as a rule, no alteration or increase of existing steam plant, no new dynamos, and usually, owing to the small space required, plenty of room can be found in the station for the storage battery.

When such a change can be made, what are the results? The available output of plant has been largely increased; no increase in working staff is required; the operating expenses are no higher than before; the all round efficiency of the station is fully 30% more, and consequently the profits are enlarged by nearly the same proportion; the plant can thereafter give uninterrupted service 24 hours per day every day in the year, as the battery is always available when a temporary shut down of the machinery is necessary.

The regulation of the voltage to the lamps is kept constant—more perfect than can be possible when no batteries are used, as the battery is a regulator to the whole system. When motors are operated this is a big advantage.

No gas company would for a minute consider the operation of their plant without a storage tank; just think of the large increase in retorts and men to keep up a constant gas supply without a storage tank. Most waterworks systems require a reservoir, and yet electrical people, who are supposed to keep abreast of the times, try to get along without a storage tank to fall back upon for hours of maximum, minimum or average demand.

The central station manager will answer that he does not know the cost of maintenance, and is waiting for the other fellow to prove the case. The other fellow has proved it. In Germantown, Pa., there has been a battery having a capacity of 120 h.p. hours in use for over three years, or long enough to give a fair idea of the cost of renewals.

The management of the large stations in Boston, Brooklyn and New York, however, did not await the results in Germantown, but put in large batteries from one to two years ago, and these have since been doubled, and in one case recently enlarged for the fourth time. But interested parties can go back of the returns from the United States for further endorsement of the practicability of accumulators.

In Germany, France and England they have been largely used for years past.

Out of a recently published list of 30 cities in Germany, only ten are without accumulator plants. The population of these cities range from 4,000 to 85,000. This shows that there is hardly a town or city electric plant but can use accumulators to advantage.

I mention the following among American companies who have put in large batteries, and the capacity installed as rated in h. p. hours:—

Company.	H. P. Hour Capacity.
Hartford Electric Co.....	3,000
Boston Edison Co., four batteries, a total of.....	7,400
New York Edison Co.....	3,200
Brooklyn Edison Co.....	1,600
Germantown Electric Light Co.....	300
Electric Railway, Light & Power Co., Anaconda, Montana..	500
Woonsocket Electric Machine & Power Co.....	400
Eastern, Pa., Edison Co.....	200

These last three plants are used both for railway and lighting work

As good an illustration as I can give of the application of the storage battery to railroad work is to refer to the equipment of the Union Traction Company of Philadelphia, who use a battery of 400 h. p. hours for keeping up the pressure at the end of a feeder at a point about 11 miles from the power house, the new extension continuing several miles beyond. In this case the battery took the place of a new power house, or what amounted to the same thing, an increase at the old power house with enlarged feed wires. It was found that the cost of copper feed wire to operate from the main power house alone would have cost four times the total cost of a battery. Previous to the installation of the battery the pressure at the end of feeder formerly in use frequently varied as much as 50%; the battery, however, gave practically a steady pressure at all times. Railroad men need not be told how much better for their motors and controllers the maintenance of a standard working pressure is than one which falls so low as to require an increase in the current passed through the apparatus of from 50 to 100%.

In the above case the load varied from one hundred to seven hundred amperes, and with the feeder of a capacity at a constant load for four hundred amperes the demand upon the power house was at all times equivalent and independent of the changeable load on the batteries.

Under such an arrangement the power house generator always operates at full load and highest efficiency, and the battery acts as a cushion to the engine when the line circuit breaker opens from any cause.

Some of the electric street railroads in Canada serve a district up to 7 miles from the power house as originally laid out, and in all cases extension will be called for to reach suburban points at a greater distance and to connect through as radical lines to still more distant points. In such work the accumulator plant at the end of a feeder is destined to be an important factor in the near future, and the little trouble in operating a sub-station for this work is very satisfying to the purchaser, as the battery is automatic in charge and discharge, the only attention required being the usual occasional testing of the E.M.F. of the individual elements and the keeping of the electrolyte to the standard specified gravity (1,200).

The sub-station apparatus and connections are very simple, being only the main switch, ammeter, circuit breaker, voltmeter and recording voltmeter. The flow of the current to the line being always proportionate to the demand, one central station can therefore take care of any number of accumulator sub-stations, and the area which can profitably be covered with continuous current either for railroads, lighting or power greatly increased.

The claim has been made and experience seems to prove it true that it costs practically nothing for the energy stored in accumulators in the average lighting, power or railroad station, whether operating on a twelve or twenty-four hour basis, as, if judgment is used in proportioning the size of battery to generating plant, the battery is always being charged during light load and discharged during hours of heavy load, and owing to the all-round higher efficiency, the amount of coal burned will be about the same and the current given off from the batteries will represent net profit.

While the above is a simple way of putting it the following gives in figures the actual conditions obtained in a plant now working:—Total time of operating steam plant, 9 hours; total steam plant required, dynamos working at an efficiency of 90%, 93 h.p.; total steam plant required, if battery is not used, 165 h.p.; saving in steam plant, 72 h.p.; total dynamo capacity required when using battery, 62,500 watts; total dynamo capacity required, without battery, 111,250 watts; saving in dynamos, 48,750 watts. In this case the battery was in service a total of 18¼ hours and during 15 hours the battery served the entire plant.

In making provision for a storage battery the room provided should, if possible, have a cement or tile floor, and should be well ventilated. Owing to the compact form of the elements, sufficient room can usually be given when arranged in tiers, one above the other. The space required for a battery capable of giving 400 h. p. for one hour per element is 14½ by 20½ inches, and as 248 cells would be used on a 500-volt system, only about 630 square feet would be necessary, this being for a battery of fairly large capacity; in fact, being equivalent to that installed by the Union Traction Company in the before-mentioned instance. A suitable battery having been purchased, it requires as careful attention as is given to any other class of electrical or steam apparatus, and no more, and yet this attention is very simple; but it must be given as required, otherwise the results would be similar to that caused by neglect of a dynamo or steam boiler. There has been no instance where a properly constructed battery that has received fair treatment has failed to give good results. Attention should be paid to the proper strength and nature of the acid, the specific gravity of the acid being tested at regular periods. The individual testing of each cell by a low reading volt-meter is the key note to successful battery operation. While in general the reading of the volt-meter connected with all the elements will give sufficient information, yet the occasional individual testing of each element prevents any single cell from being allowed to work at a disadvantage. The chloride type of negative plate has been found to be most satisfactory, and is largely in use for central stations. The positive plates generally used with chloride negatives are of the Tudor type, and are capable of giving a very high discharge, their capacity being at nominal rating from three to five ampere hours per pound of element. Such a battery is not liable to buckle or sulphate. There are numerous small water powers that have not been considered as applicable to electric lighting owing to the small h.p. available, but if 20 h.p. can be obtained for 24 hours per day, and if a battery is used in connection therewith, 120 h.p. is available for four hours, or sufficient for the requirements of a fair-sized town. I know of one instance, in a

town of from eight to ten thousand inhabitants, where a water power of 50 h.p. is available, and not used at present. This power, if stored in batteries, would give 200 h.p. for six hours, or sufficient to supply all the street commercial and residential lighting which is now operated by steam.

SPARKS.

Mr. L. O'Connor has been appointed electrician of the town of Thorold, Ont.

An electric light plant will shortly be put in running order at Woodville, Ont.

The town of Tilbury, Ont., will vote on a by-law to raise funds for improving the electric light plant.

The Goldie & McCulloch Co., of Galt, Ont., are building a 150 horse power engine for a flour mill in South Africa.

Mr. Henry Surtees, son of the city engineer of Ottawa, has been engaged as chief electrician of the Quebec District Electric Railway.

Mr. Geldart, engineer for Messrs. Dymont & Baker, London, Ont., in renewing subscription to the ELECTRICAL NEWS, states that he finds the paper very interesting and instructive.

By the collision of a freight motor and a passenger trolley car on the Galt, Preston and Hespeler electric railway, several passengers and the conductor and motorman were slightly injured.

Wm. Snider & Co., who have recently entered the electric lighting field at Waterloo, Ont., are putting in a 75 horse power Corliss engine to operate their dynamos, which were purchased from the W. A. Johnston Co., of Toronto.

Only one tender having been received for lighting the town of Owen Sound by electricity, the Fire and Light Committee of the council have recommended the purchase of a civic lighting plant, the cost of which is estimated at \$27,000.

We are informed by Col. Stacey, of St. Thomas, Ont., that arrangements are likely to be completed at an early date for the conversion of the street railway in that town to an electric system, with radial lines extending to the adjacent villages.

A proposition was recently made by the Chatham City and Suburban Electric Railway Company to construct a radial railway, with the city of Chatham as the centre, and to supply that town with 100 electric lights at \$7,500 per year. The arrangement was to take the form of a bond guarantee, given by the city of Chatham, under which the company could float its securities. Voting on the by-law took place on May 29th, but the result was the defeat of the proposition. Col. Geo. C. Rankin was one of the promoters of the enterprise.

The longest electrical transmission plant in the Dominion of Canada was put in operation May 13, 1897, near Three Rivers, Que. This plant was installed by the Royal Electric Company of Montreal for the North Shore Power Company, and transmits 700 h.p. from Grand Chute, on the Batiscan river, a distance of 17 miles, to the city of Three Rivers, Que., where the power is used for arc and incandescent lighting, as well as for power. S. K. C. two-phase apparatus is used throughout. A full description of this, the first long distance plant of such high voltage in Canada, will be published very shortly.

By a regulation of the Inland Revenue Department made on May 7th, 1897, a change has been made in the inspection of electric light meters, by which the charge is now made according to the number of lights instead of amperes. It was found that the regulation of the fees by amperes was so perplexing that it was advisable to change the basis, and the rates are now as follows: Meters of 10 lights and under, 75 cents; over 10, and under 20, \$1.25; over 20, and under 30, \$1.75; over 30, and under 45, \$2.25; over 45, and under 60, \$2.75; over 60, and under 80, \$3; over 80, and under 100, \$3.50; and for every 20 additional lights, or fraction thereof, 50 cents. A light means a 16 candle-power incandescent lamp, consuming electrical energy at the rate of 15 watts.

TRADE NOTES.

The London Electric Motor Company, of London, Ont., has recently installed a ten h.p. motor for Norway Cabinet Co., and a two h.p. motor for Mr. Wilcocks, corner Dufferin and Dundas streets, Toronto.

The W. A. Johnson Electric Company, Toronto, are at work on the dynamos for two new steamboats for the Lake of the Woods and Seine River mining district. They also report recent sales of their motors to Montreal, Kingston, Ottawa, Berlin, Preston and Toronto.

On the 1st of April, conducted by Mr. O. E. Granberg, Boiler Inspector, and Mr. Alfred Trevethick, M.E., Montreal, a test was made of the Jones Underfeed Mechanical Stoker, recently installed at the Windsor Hotel in that city. The result is said to have shown an economy over hand firing under former conditions of 46.7 per cent. The T. Eaton Co., Ltd., of Toronto, are replacing three Hawley down draft furnaces with the improved stokers.

The W. A. Johnston Electric Company, Toronto, report the sale of direct current generators and engine and boiler for the new mining town of Minc Centre, Ont., this plant to be used for commercial lighting and power. They have made a recent shipment to the Lachine Rapids Hydraulic & Land Company of one ear load of Wagner transformers, weighing 44,000 lbs., and of a capacity of 18,000 lights, and announce a further sale to the same company of 450 kilowatt transformer capacity and voltage 4,000 x 1,000 volts.

EDUCATIONAL DEPARTMENT

INTRODUCTORY

After mature deliberation the publisher of this journal has decided to devote a certain amount of space each month to what may be termed an Educational Department, wherein both mechanical and electrical formula and mathematical problems will be discussed, illustrated, and as far as possible rule and example given. At the request of the editor, I have with pleasure undertaken to contribute to this department regularly each month, and before discussing actual mathematical problems, wish to briefly introduce the subject at issue.

The primary object of this department is chiefly to increase the value of an already valuable paper, by placing in the hands of every engineer who has any knowledge of the rudimentary principles of mathematics, such matter as will enable him by a little study to master the most intricate mechanical and electrical formula. Many of our most valuable engineering works and publications from time to time contain formula that is in many cases but vaguely understood, and very often entirely misunderstood, thus rendering an otherwise valuable work practically valueless to the reader.

Just at what particular point our calculations should commence became a matter of serious thought, and past experience had to be carefully considered, bearing in mind the fact that there are many really good engineers whose early education has, through force of circumstances, been deficient, and many others who, through lack of opportunity, have not been able to review their early education for years. Knowing by observation and experience the great necessity of having a thorough elementary education before attempting to digest and calculate problems, and the almost utter impossibility of the student arriving at a satisfactory conclusion of his studies without a thorough knowledge of the principle of mathematics involved, I have decided to commence at a point and carry out the programme outlined in this journal—commencing at the foundation and advancing by easy stages until the principles underlying the most obtuse and difficult formula can be readily explained and easily understood. The advantages to be derived from an education of this kind, coupled with practical mechanical ability, is too well understood to require comment.

The programme which has been outlined for the succeeding nine months will embrace:

DECIMAL FRACTIONS—Definitions and explanation of principles of, and method of reduction to common fractions, and vice versa.
SQUARE AND CIRCULAR MEASURE—Definition and explanation and practical demonstrations of.
CUBICAL AND CYLINDRICAL MEASUREMENTS—Definitions and explanations of, with practical hints.
SQUARE AND CUBE ROOT—Definitions and explanations of.
SAFETY VALVE CALCULATIONS—(Spring and Lever Types)—Principles of, with practical demonstrations.
BOILER CONSTRUCTION—Stays, rivets, joints and seams, iron and steel plate—strength of, with formula and practical demonstrations.

It is not the intention to fill these columns with a mass of figures hastily compiled without reference to any particular object; on the contrary, every problem will be carefully thought out, and only such information given as will be of use to you, and an effort will be made, based on experience and a knowledge of the requirements, to make this series of tests complete in every particular.

WM. THOMPSON.

[ARTICLE II]

DECIMAL FRACTIONS.

A DECIMAL fraction is one whose fractional units are tenths, hundredths, thousandths, etc.

[NOTE.—The denominator of a decimal fraction is not expressed as in common fractions; instead of expressing the fractions $\frac{1}{10}$, $\frac{1}{100}$, $\frac{1}{1000}$, they would be decimally expressed as .1, .01, .001.]

The decimal point is the character (.). It signifies the decimal when placed on the left of the fractional units expressed, and separates the integer from the decimal, as it is on the right of the former and on the left of the latter.

Decimal places consist of the number of figures on the right of the decimal point.

The value of each place is shown in table of decimal notation :

DECIMAL NOTATION.									
Hundred Millions " Ten Millions			Hundred thousand " Ten Thousands			Hundreds Tens Units			Decimal point
4 0 1			2 3 5			4 0 9			
{ 9th 8th 7th			{ 6th 5th 4th			{ 3rd 2nd 1st			
Integers						Decimals			
						{ 1st 2nd 3rd			
						{ 4th 5th 6th			

Example (2): Multiply .75 by .625.

$$\begin{array}{r} .625 \\ \times .75 \\ \hline 3125 \\ 4375 \\ \hline .46875 \end{array}$$

Since both factors contain five decimal places we point off this number in product.

Example (3): Multiply .0625 by .075.

$$\begin{array}{r} .0625 \\ \times .075 \\ \hline 3125 \\ 4375 \\ \hline .0046875 \end{array}$$

Since both factors contain seven decimal places and product but five, we require to prefix two ciphers, and set decimal point to the left.

DIVISION OF DECIMALS.

Division of decimals is the process of finding the quotient when either the dividend or divisor or both are decimals.

Rule: To find the DECIMAL QUOTIENT when the divisor and dividend are both whole numbers, and the divisor is greater than the dividend, or when the divisor is not contained in the dividend an exact number of times.

Add as many ciphers to the dividend as there are decimal places required in the quotient, divide as in simple numbers, and point off from the RIGHT of the quotient as many decimal places as there have been ciphers added to the dividend, and USED, prefixing ciphers to the quotient if necessary.

Example: Divide 75 by 1506 to 4th decimal place.

Process as per rule:

$$\begin{array}{r} 1506 \overline{)75.0000(.0498} \\ \underline{6024} \\ 14760 \\ \underline{13554} \\ 12060 \\ \underline{12048} \\ 12 \end{array}$$

Since we wish to extend to fourth decimal place only, we annex to dividend four ciphers and proceed as in division of simple numbers, and get 498. Since, however, we annexed four ciphers to the dividend, and therefore require four decimal places in the quotient, we must prefix one cypher, and quotient will then read .0498, proving that the factor 1506 is contained in the factor 75 .0498 times, or that 75 is 0498% of 1506.

Example (2): Divide 743 by 125.

$$\begin{array}{r} 125 \overline{)743.000(5.944} \\ \underline{625} \\ 1180 \\ \underline{1125} \\ 550 \\ \underline{500} \\ 500 \\ \underline{500} \end{array}$$

Here we have an example where two whole numbers are to be divided an exact number of times. Since we find the divisor is contained in the dividend 5 and a fractional times, we add to the dividend a cypher and bring this down and annex to the right of the remainder, as in division of simple numbers, repeating this process until there is no remainder. We then proceed to ascertain the number of ciphers annexed to the dividend, and point off a corresponding number of places in the quotient, counting from the right. In example the 125 is contained in 743 exactly 5.944 times.

Example (3): Divide .9735 by 50.

$$\begin{array}{r} 50 \overline{).9735(.01947} \\ \underline{50} \\ 473 \\ \underline{450} \\ 235 \\ \underline{200} \\ 350 \\ \underline{350} \end{array}$$

Here we divide a decimal by a whole number, proceeding exactly as before, and since the decimal contains four places to the right of the decimal point, and we require to add a cipher so as to have no remainder, we necessarily require quotient to contain five decimal places, and have to prefix a cipher to the quotient to bring about this result.

To divide when both divisor and dividend are decimals, and the divisor contains more decimal places than the dividend—

Rule: Add ciphers to the dividend until it shall have as many places as the divisor; then proceed as in simple numbers.

Example: Divide .125 by .0515.

$$\begin{array}{r} .0515 \overline{).12500000(2.4270} \\ \underline{1030} \\ 2200 \\ \underline{2060} \\ 1400 \\ \underline{1030} \\ 3700 \\ \underline{3605} \\ 950 \end{array}$$

This is an example of the application of principle 1. While we annex to the dividend a cipher we in no way change its value, and since we find .0515 to be contained in .125 two and a fractional times, we proceed by process already illustrated to extend to the fourth decimal place.

To divide when both divisor and dividend are decimals, and the dividend contains more decimal places than the divisor—

Rule: Divide as in simple numbers, and point off from the right of the quotient as many decimal places as the decimal places in the dividend are greater in number than those in the divisor.

Example: Divide .5000 by .125

$$\begin{array}{r} .125 \overline{).5000(4.0} \\ \underline{500} \\ 000 \end{array}$$

The application of both these rules is demonstrated in previous example. Since, however, we want to make the principle clear, we repeated in another form. The writer wishes especially to impress on the student the great importance of thoroughly mastering the principles of calculation contained in these exercises in common and decimal fractions. A thorough knowledge of the principles involved is of immense benefit in computing much of the formula we shall at a later date meet with; in fact, unless our knowledge of these principles is thorough we cannot hope to properly appreciate all the good things that the scientist has prepared for us.

There remains for illustration yet what concerns many of us, i.e., the principles involved during the conversion of common to decimal fractions and vice versa, which I will briefly illustrate before closing this number.

Since the denominator of a simple fraction is always larger than the numerator, to reduce or convert a common fraction to its equivalent decimal fraction we have to follow one of the rules already laid down for the division of decimals, dividing the numerator by the denominator and adding ciphers as required.

Example: Reduce $\frac{1}{5}$ to a decimal fraction.

$$\begin{array}{r} 16 \overline{)15.0000(.9375} \\ \underline{144} \\ 60 \\ \underline{48} \\ 120 \\ \underline{112} \\ 80 \\ \underline{80} \end{array}$$

Since we had to add to dividend four ciphers, we place the decimal four places to the left, counting from the right, hence $\frac{1}{5}$ reduced to decimals = .9375.

Example: Reduce .9375 to common fractions.

Since the numerator is 9375 and the denominator 1, with as many ciphers added as there is decimal places in the numerator, then fraction will be set thus $\frac{9375}{10000}$, which we reduce to simplest form:

$$\frac{9375}{10000} = \frac{5 \cdot 1875}{5 \cdot 2000} = \frac{5 \cdot 375}{5 \cdot 400} = \frac{5 \cdot 75}{5 \cdot 80} = \frac{15}{16}$$

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HOW TO SELECT AN ELECTRIC PLANT.

BY GEO. WHITE-FRASER.

At this present there are in the Dominion six different types of alternating machines manufactured in the country; six different types of arc machines; seven of direct current; four, if not five, different types of transformers. Besides these, that are all of Canadian manufacture, there are several American manufacturing companies who have agencies in the principal cities in the Dominion. It is not, therefore, any exaggeration to say that persons desirous of purchasing a generator can choose from probably at least ten different makes, all of them presumably good. The science of electrical design and construction is not by any means the monopoly of one or two individuals, nor need it by any means follow that the most wealthy manufacturer will get out the best machinery. Because A sells five times as much machinery as B does, it is not a safe assumption that A's machinery is greatly better than B's, unless there be some other evidence in support of it. The safe assumption is that A can afford to advertise more widely than B. There is no good reason why the very best machine should not be sent out of the smallest shop, nor is there any good reason for assuming that any one machine is better than any other machine simply because it bears a well-known name. Of the designers of the ten different machines referred to above, probably every one had the same facilities for acquiring technical knowledge, probably studied the same text-books; they can all buy their copper and iron in the same market for the same price, therefore there is no reason for crediting one particular machine among them with inherent superiority to the others. In fact to do so would probably be to unjustly decry the others. At the same time, it is only reasonable to suppose that ten different designers, working independently, and in competition, will produce results which, although all very good, will differ among themselves and present features which will appeal to different persons with varying weights. And so it is in fact—these ten makes include no less than six different types, and each one of the ten discloses different data. One make has a high full load and a low half load efficiency; a second reverses this. A third compounds the machine with an ironclad armature; a fourth claims superiority for a rotating field, while others say this, that and the other; and as they all ask different prices, it is sometimes no easy matter to come to a fair and correct decision as to their true comparative values to the purchaser. As such purchaser is going into electric lighting as an investment for money, it becomes a serious consideration for him, which really is the best machine as an investment—which one will make most money for him? Even before this, comes the question, "Is an alternating or a direct current system better for such and such a particular case?" This is not a fanciful consideration at all, but one having a direct bearing on dollars and cents. The alternating system was developed to meet peculiar conditions, and unless those conditions exist it has no advantage over the D. C. It is a question of prices principally, and so directly affects the pocket of the purchaser. The cost of an electric lighting plant includes generator, belts, wires, transformers, lamps, etc., and although an alternating 1000 volt generator may cut down the cost of distribution wires very greatly, it must be remembered that transformers will be necessary, and their cost will bring up the price of the alternating system with small wires more nearly to that of the D. C. system with larger ones. Assuming even that the cost of the two systems is the same, the D. C. possesses the advantage, because it has no transformers to introduce copper and iron losses. It will therefore be evident that whether an alternating or a direct current system is better for any particular case depends entirely on local conditions and the prices at which machinery and apparatus can be purchased. For certain conditions the D. C. is distinctly the best; for others it will be immaterial which is adopted, while for still others the alternating should be preferred.

Then "what size of plant will be the best investment?" Local conditions in this case again should decide. To

blindly jump to the conclusion that a "1,000 lighter" is best is simply to lend money without inquiring as to the security. The capacity of a plant should be decided on with direct reference to the population, the class of residences, the number of stores, hotels, churches, halls, etc. It is not the total number of lights wired up that should decide the generating capacity, but the estimated maximum amperage at full load, which is very different. If the number of store lights is a very large proportion of the total, a generator of greater amperage will be required than if there be few stores and a number of residences. In an average town of 2,000 population it is a great mistake to place a so-called "1,000 light" machine, or a 60 k.w. It is very improbable that more than 1,200 lights can be sold altogether, including residences, churches and hotels; and most likely the greatest number of lights burning at any one time during the year will not exceed 800, while the minimum will be 100 (this has been the writer's experience). A 50 k.w. machine will give this perfectly well if well constructed, and will not only be less expensive to buy, but will require a smaller engine, less steam, etc., and so save money. Under these circumstances a 50 k.w. is the better investment. When these matters have been settled, and tenders are in from the various manufacturing companies, it may be supposed that it is a simple matter to make a proper selection. It is, however, not so, as will appear from the following illustration taken from an actual case.

Specifications called for a 35-ampere, 2,000-volt alternator, and six tenders were received, the proposed data being as under:—

Tender.	Type of Armature.	Amperes.	Efficiency.	Regulation.	Heat Limit.	Price.	Make.
A	Ironclad	30	90%	Compound	70° F.	\$1,900	Canadian
B	Inductor	35	90%	6%	70° F.	2,100	"
C	.....	35	90%	6%	70° F.	1,750	Imported
D	Toothed	30	90%	Compound	50° F.	1,510	"
E	Surface	30	9%	Compound	....	1,447	Canadian
F	Inductor	30	92%	8%	50° F.	1,750	Imported

The armature of "C" was a peculiar type, ribbon wound, quite excellent, not classed either as Inductor nor Ironclad nor Surface. Armature of "D" was not strictly ironclad, but possessed machine wound coils slipped over polar projections on a rotating armature. Which of these machines was the best investment? Judging on a purely price basis "D" was the best; on a purely ampere-wattage basis "B" and "C" were equally good; in point of efficiency "F" was much the best; in point of regulation the compound wound ones should be taken. The best limit of "D" and "E" was 20° better than the others. Which is the most important consideration? The one with the highest efficiency, "F," is \$260 more expensive than the lowest in price, but has 2% higher efficiency, and equal heat limit. What is the money value of this higher efficiency? for "F" is undoubtedly entitled to ask a higher price than "D."

The considerations that should decide the selection are:

I. Electrical and mechanical efficiency.

II. Mechanical excellence, and probable freedom from repairs.

III. Heat limit and regulation.

IV. Price.

Taking No. I consideration it seems plain that A and B are out of it; they are the highest in price, highest heat limit and lowest in efficiency. They may therefore be dropped unless any importance is to be attached to home manufacture. In the particular case from which the illustration was taken E was ruled out for reasons having no place here. That left the matter between C D F. These three machines therefore must be compared, and in order to do so it is necessary to reduce them all as far as possible to some standard. It is convenient to reduce them all to the standard of F in point of efficiency, which means that as both C and D will require more coal burnt to generate the same amount of current as F, it is only fair to F to add on to the prices of C and D the capitalized value of the extra coal consumption. It is evident that C will thus have a higher price than F, and as the 20° lower temperature guaranteed for F

at 30 amperes may be assumed to compensate for the extra 5 amperes guaranteed for C, we may drop C out of the question, and compare D and F. This difference in efficiency of 2% will cause an extra consumption of at least \$15 worth of coal per annum, or capitalized at 5%, a difference in value of \$300. This will bring up the price of D to \$1810. The new values for the machines, taking efficiency into account, will be therefore: A, \$2200; B, \$2400; C, \$2050; D, \$1810; F, \$1750.

Now take No. II, or mechanical excellence and probable freedom from repairs. Any unprejudiced person would at once admit that B, C and F, owing to their construction and design, were probably less liable to injury than any of the others, and more easily repaired if injured; and that D was in this respect better than A. The fact that C and F are imported machines is of practically no importance at all, for nowadays any competent mechanic can repair any armature, and nearness to the factory where it was made is of negligible advantage.

Considerations III and IV have already been taken.

The result of the whole thing is that as an investment F is the best machine.

It is, however, very wrong policy to accept paper guarantees with no intention of proving them by actual test. In the above case F was chosen on the merits of guarantees; if those claims be not fulfilled, then F is not worth as much money relatively as was asked for it. If, therefore, the machinery is bought on the basis of guarantee only, without any subsequent test, then the most reputable makers will always be left out, and the most worthless machinery be taken. It is not a difficult matter to make tests, and it ought always to be done. The purchaser who formulates no scheme of his own, but requests not only tenders, but also suggestions and advice from different makers, is doing an actual injustice to every manufacturer in the market, and also to himself. Every manufacturer is honestly intending to sell good stuff and give good advice, but as they may not all look at the thing the same way, the result will be that a good many will tender on larger machinery than the purchaser will be satisfied with, and will consequently lose business through no fault of their own. A purchaser should give every one a chance, and not give any inside tracks or undue favor. And above all things—an electric lighting or power business should be recognized as an investment for money, and as subject to the same business principles that guide all other business.

A LONDON ELECTRIC LIGHT PLANT.

MESSRS. D. S. Perrin & Co., of London, are putting in an entirely new engine and boiler plant for their large factory, together with the first isolated electric light plant in London. The plant and system are being installed under the supervision of Mr. J. H. Dickson, consulting engineer, of London, and consists of a 75 h.p. 13 x 50 Wheelock engine, from the shops of Goldie & McCullough, Galt; two 66 x 16 boilers, carrying 100 lbs. pressure, with new and improved system of forced draft, using a 70 in. steel blower, having 550 revolutions to the minute. The blower only consumes 4½ h.p. running full capacity. They are also putting in a light generator from the works of the London Construction Co., and a 10 h.p. motor, 250 volts, the latter to transmit power across street to one of their factories, thus enabling them to abandon the tunnel under the street which they have hitherto used. Their volt meter

is from the well-known German firm, Allgemeine Electricitats Gesellschaft, of Berlin, Germany. A new octagon chimney, 50 ft. high, 46 in. diameter, is also being built. All returns from steam heating kettles are returned to an automatic tank pump. The boiler room is fitted with exhaust heater and duplex pump. When finished this plant will be a credit to London, and speaks well for the enterprise of the firm.

MOONLIGHT SCHEDULE FOR JUNE.

Day of Month.	Light.	Extinguish.	No. of Hours.
	H.M.	H.M.	H.M.
1.....	P. M. 7.50	A. M. 4.00	8.10
2.....	" 7.50	" 4.00	8.10
3.....	" 7.50	" 4.00	8.10
4.....	" 9.40	" 4.00	6.20
5.....	" 10.10	" 4.00	5.50
6.....	" 10.40	" 4.00	5.20
7.....	" 11.20	" 4.00	4.40
8.....	" 11.50	" 4.00	4.10
9.....	.....	.....	.....
10.....	A.M. 12.20	.....	3.40
11.....	" 12.50	" 4.00	3.10
12.....	" 1.20	" 4.00	2.40
13.....	" 1.50	" 4.00	2.10
14.....	No light.	No light.	....
15.....	No light.	No light.	....
16.....	No light.	No light.	....
17.....	P. M. 8.00	P. M. 10.20	2.20
18.....	" 8.00	" 10.50	2.50
19.....	" 8.00	" 11.30	3.30
20.....	" 8.00	A. M. 12.00	4.00
21.....	" 8.00	" 12.20	4.20
22.....	" 8.00	" 12.50	4.50
23.....	" 8.00	" 1.10	5.10
24.....	" 8.00	" 1.40	5.40
25.....	" 8.00	" 2.10	6.10
26.....	" 8.00	" 2.40	6.40
27.....	" 8.00	" 3.20	7.20
28.....	" 8.00	" 4.00	8.00
29.....	" 8.00	" 4.00	8.00
30.....	" 8.10	" 4.00	7.50
.....			
Total,			139.10

The Sherbrooke Gas & Water Co., Sherbrooke, Que., have recently made extensive additions and alterations in their plant. Their station has been enlarged, and they have also installed two additional water wheels. They have increased their electrical plant by one 180 k.w. and one 75 k.w. S. K. C. two-phase generators, in addition to the 75 k.w. S. K. C. two-phase generator which they purchased about a year ago from the Royal Electric Company, and which makes their plant one of the most complete incandescent plants in the Dominion. The management of this company have installed a power circuit from their alternating two-phase apparatus, and are now serving power and light successfully from the same generators and lines.

It is said that there are 560 miles of electric roads in Europe, which is an increase of 125 miles in one year. The number of electric cars has increased from 1236 to 1747 in the same time. Germany has 250 miles of electric roads, and 857 motor cars. France has 82 miles, and 225 motor cars. Great Britain has 65 miles, with 168 cars, and Austria-Hungary has 45 miles, with 157 cars. Next comes Switzerland, Italy, Spain and Belgium, in the order given, while Russia has but one electric railroad, with 6 miles of track and 32 motor cars, and Portugal ends the list with 1½ miles. Of the 111 European lines 91 are overhead trolleys, of which there were 35 in Germany, 12 in Switzerland, 10 in France, and 7 each in England and Italy, and 6 in Austria, Hungary, etc. Of electric roads with underground current there were but three at the beginning of this year, one each in England, Germany and Hungary. Nine lines are provided with an insulated central track, through which the current is conducted, eight of these railroads being in Great Britain and one in France. The remaining eight lines are provided with accumulators. Of these, four are in France and two in Austria, and one in England and the Netherlands.

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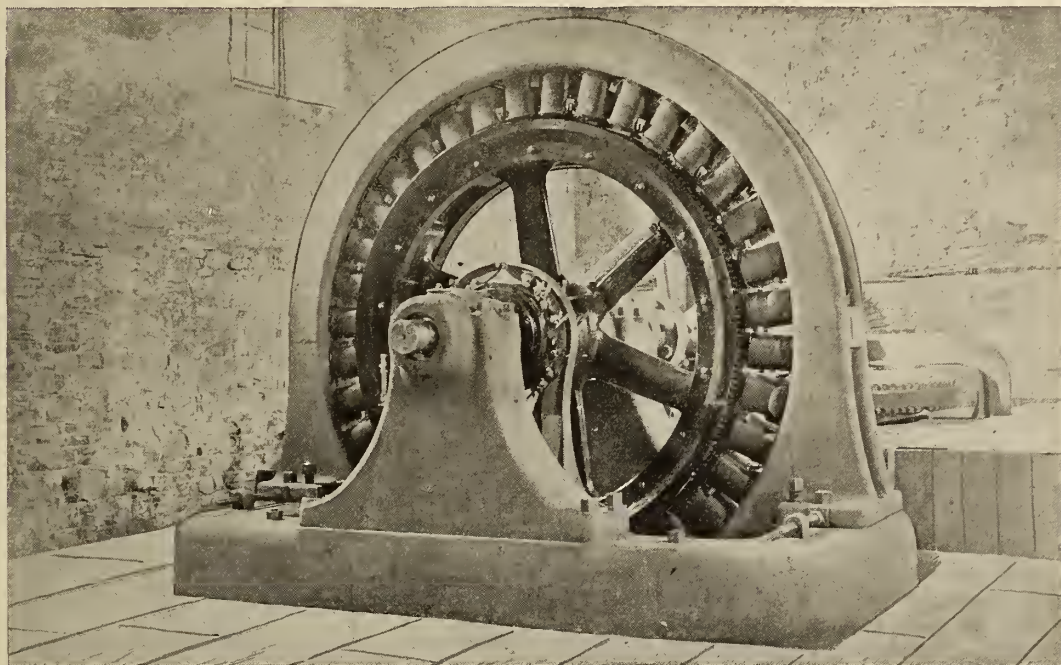
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SPARKS.

Watford, Ont., has two rival electric light companies, both having recently installed new plants.

It is the intention of the London Street Railway Company to extend their line to the village of Pottersburg.

The Electric Light and Power Company have offered to furnish the town of Dundas, Ont., with 25 street lights of 1,600 candle power for 300 nights a year at \$61.25 each.

The steamer Acadia, recently put on the St. Lawrence route by the Hamburg-American Packet Company, is fitted with quadruple engines of 2,500 horse power and lighted by two dynamos.

The McCormick Mfg. Co., of London, have changed their steam cooking system. The work was superintended by Mr. F. Mitchell, and the test now running shows a saving of fully 45% in fuel.

An Austria fluid designed to prevent boiler incrustation is composed of water, calcined soda, oil soot, pulverized zinc, caustic lime and mineral oil, to which blend are added tannin and tartaric acid.

Mr. C. E. Evans, manager of the Quebec District Electric Railway Company, expects to have the road completed before the first of July. Several cars have already been received from the manufacturers.

The city council of Chatham, Ont., by a vote of the ratepayers taken in February last, were authorized to purchase an electric light plant, and steps looking to that end are now being taken. The present contract for street lighting expires on September 1st.

In Gananoque, Ont., there are sixteen arc and eight incandescent lights, costing \$1,216 a year, or \$70 for each arc and \$12 for each incandescent. Under a new five years' contract there will be twenty-one arcs for \$1,200, and nine incandescents for \$80; total, \$1,280.

The Montreal Belt Line Railway Company officially opened their road to Bout de l'Isle last month. The line is twelve miles in length, and is thoroughly equipped. The officers of the company are: W. Dale Harris, president; Charles Desmarteau, vice-president; J. P. Mullarkey, managing director. It is expected to continue the road down the north shore of the St. Lawrence a considerable distance, and eventually to Berthier.

The Bell Telephone Company won the case brought against it by the United States to annul the last Berliner patent. This decision has the effect of continuing the control of the telephone by the Bell Company for seventeen years from the date of the last patent, which was granted in 1891. The government asked to have the patent of 1895 set aside on the ground that the delay of thirteen years in the patent office was fraudulent and the fault of the telephone company, and that the patent issued in 1880 covered the same ground on which the new patent was applied for in 1891. Justice Brewer said that there was no evidence of corruption or undue influence exercised over the patent office by the telephone company, and that there was no evidence that the delay in granting the patent had been brought about by the company. It held that whatever delay there had been was through the fault of the patent office.

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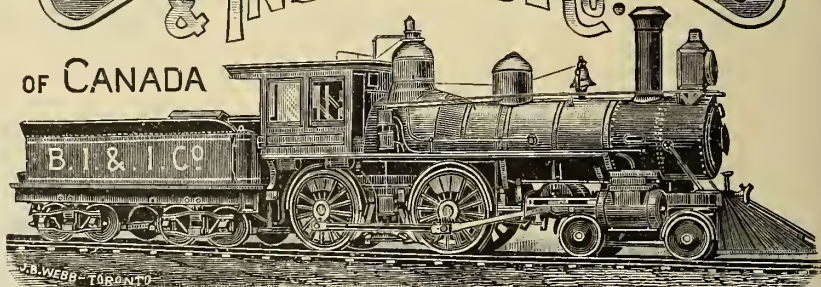
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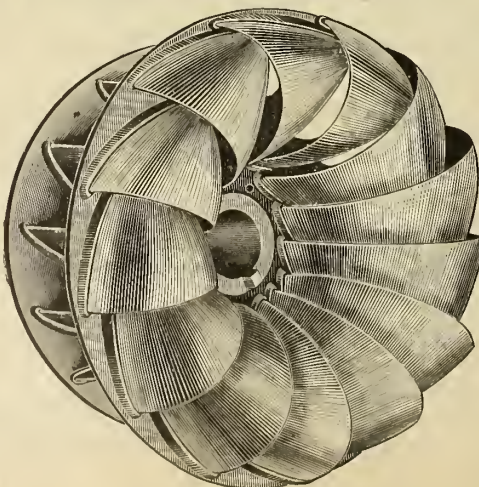
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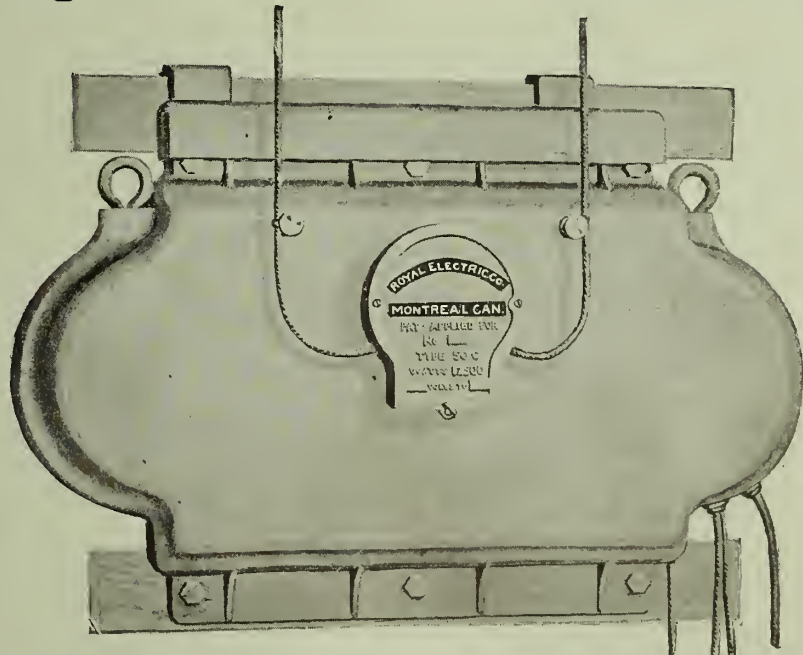
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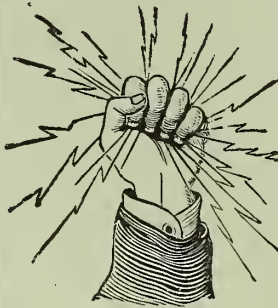
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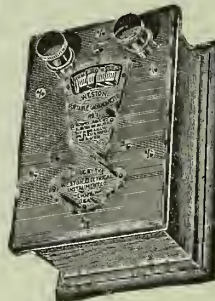
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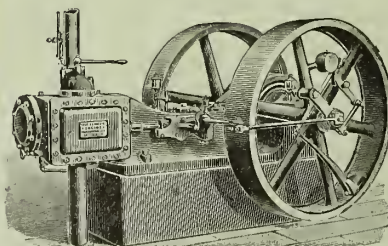
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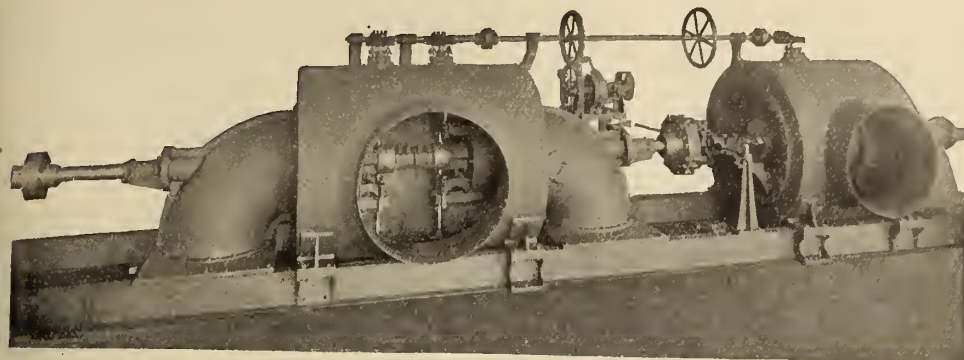
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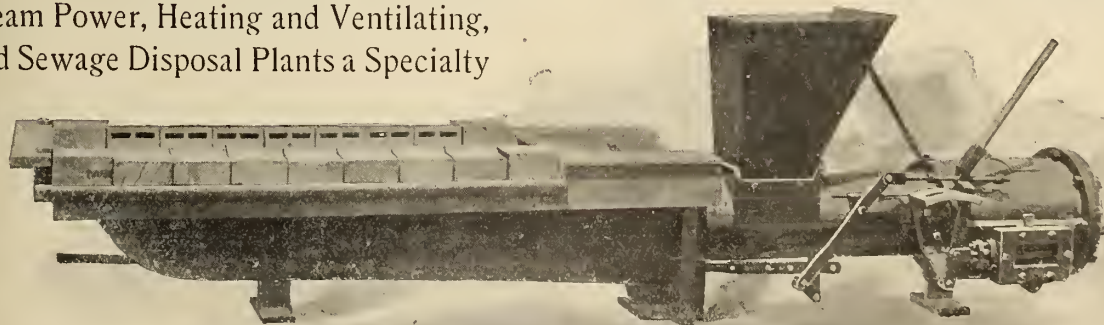
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Vol. VII.

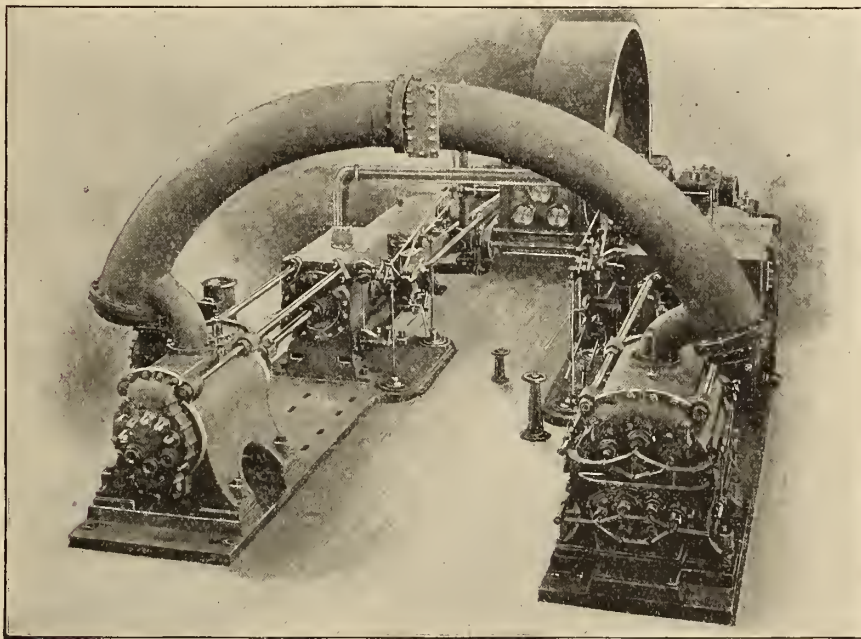
JULY, 1897

No. 7.

AIR COMPRESSOR AT LE ROI MINE.

WHAT is claimed to be the largest air compressor ever put in operation in Canada was recently installed at the Le Roi mine, Rossland, B. C., by the Rand Drill Company, of 100 Broadway, New York. It was built at their Canadian shops at Sherbrooke, Que., and is shown in the accompanying illustration.

The steam end is of the Corliss cross-compound condensing type, with high-pressure cylinder 22 inches in diameter by 48-inch stroke, taking steam through a pipe 6 inches in diameter. The low-pressure cylinder on the opposite side of the machine is 40 inches in diameter by 48-inch stroke. Both cylinders are fitted with the Corliss liberating valves, with vacuum dash pot, controlled by a sensitive governor operating on the releasing gear, the speed being automatically governed from six or eight revolutions to the maximum number of revolutions per minute, depending upon the air pressure. The main shaft is 14 inches in diameter by 13 feet



AIR COMPRESSOR AT LE ROI MINE, ROSSLAND, B. C.

long, weighing about 5,500 pounds. The shaft is fitted with cranks pressed on under immense pressure. The connecting rod forgings and piston rod forgings are well and carefully finished. The air end of the machine is placed tandem with the steam cylinders, and is also of the compound type, the high-pressure air cylinder being 22 inches in diameter by 48-inch stroke. The valve motion supplying these cylinders is Rand's most economical type, being in the form of mechanical valves. The use of these valves insures the filling of the low-pressure cylinder with air at atmospheric pressure, which fact largely affects the efficiency of the machine, for were the cylinder either not completely filled, or were the air hot and expanded, in just such a ratio would, it is said, the efficiency be decreased. The inlet valves of the low-pressure or intake air cylinder are surrounded by a hood, which is connected to a flue for the introduction of the cold air from out of doors. Between the high and low-pressure cylinders is an intercooler of the latest

type, through which the air passes over a system of water circulating pipes and is cooled in the process. This giant compressor engine will be used for running all the pumps and hoists at the mine, in addition to operating 40 drills.

NOVEL METHOD OF UTILIZING WATER POWER.

PARTICULARS of a new method of utilizing the power of falling waters are given as follows in the Mining and Scientific Press:—

The essential principal involved is the compression of air by the force of the falling water, and the compressed air used to drive motors at the falls or be transmitted to a distance for the same purpose. From a tank or a stand-pipe, in which the water stands at the same level as above the dam, the water is permitted to pour down a pipe, around whose base are a number of holes, admitting air from tubes running up to the surface of

the water. The air is sucked in and compressed by the water, and the two are automatically separated by gravitation, the air passing into a storage or supply chamber. The incredible statement is made that from 70 to 80 per cent. of the latent energy in the falling water can be rendered available in this manner. This is no more than a turbine yields, but the latter cannot transmit its energy to a distance within the interpolation of dynamos and motors in which some loss of power occurs. It is said a plant operating on this principle is to be installed at the Dominion Cotton Mills in Magog, near Montreal.

Kinetic energy is the energy of motion. Thus, if a fly-wheel is in rapid motion it possesses kinetic energy.

Potential energy is the possibility of doing work possessed by a body. If a heavy stone is placed at the top of a high building it possesses potential energy. If dislodged it will do work in falling. There is in the stone the possibility of work.

THE "ECONOMETER."

THE following is a description of an instrument, called the Econometer, designed to indicate permanently the conditions of combustion in boiler and other furnaces. This apparatus is designed to prevent a loss of heat resulting from an excessive amount of superfluous air passed through the furnace, and which has to be heated to the high temperature of the exit gases. If just as much air could be conveyed to the fuel as it needs for perfect combustion, the combustion gases would contain about 21 per cent. of CO_2 , as atmospheric air contains 21 per cent of oxygen. Carbonic acid being formed by the combustion of the carbon with the oxygen of the air, it follows that the percentage of CO_2 in the gases is larger the less superfluous air is admitted to the furnace. As this instrument shows continuously the amount of CO_2 in the gases, it is a permanent indicator to the stoker to regulate its firing according to its indications.

The Econometer consists of a finely adjusted balance

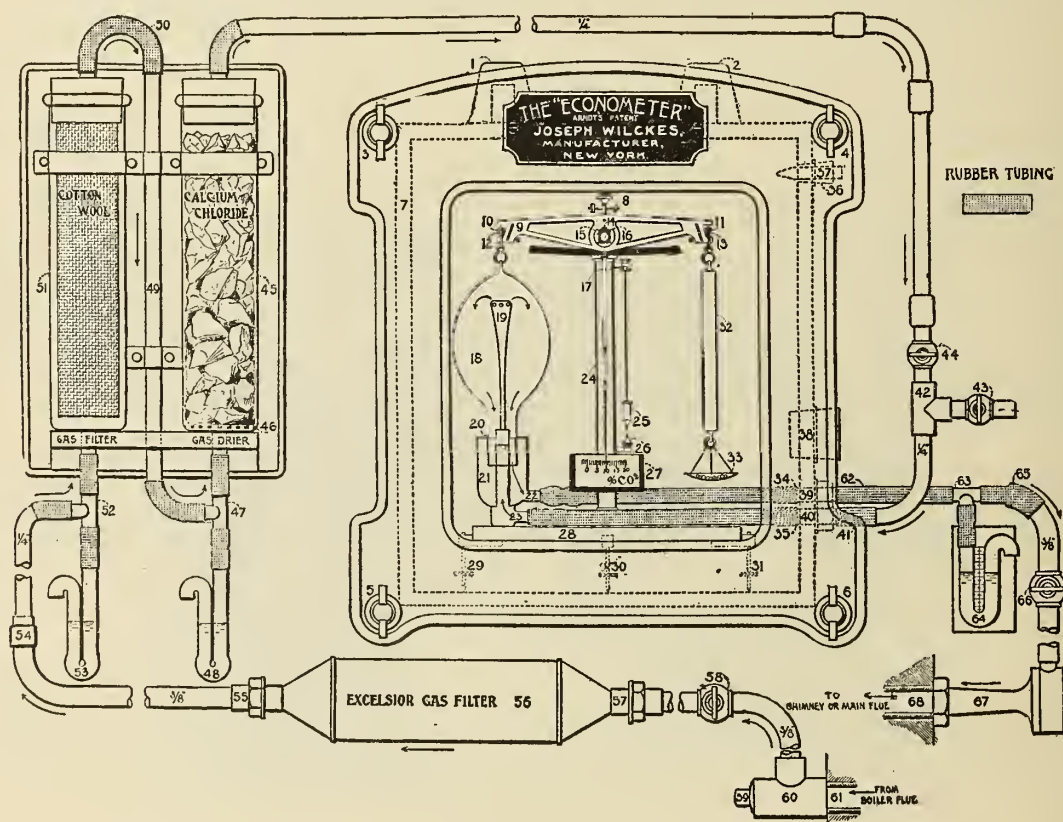
plus of air would be shown by lower readings. Thus the stoker is enabled by proper attention and regulation of the damper to get the best possible results from the fuel.

The Econometer is being introduced in the United States and Canada by Mr. Joseph Wilckes, of 106-108 Fulton street, New York. It is largely in use in most European countries, and several have also been installed in the United States.

Messrs H. McLaren & Co., 706 Craig street, Montreal, are the agents for Quebec and the eastern part of Ontario. They will be glad to give any further information.

DEVELOPING AN IMMENSE WATER POWER.

THE West Kootenay Power and Light Company, Limited, which was recently organized for the purpose of developing the magnificent water power available at the Falls of the Kootenay, in British Columbia, ten miles from Nelson, has just closed a contract for the hydraulic



enclosed in an iron case. The gases are taken from the boiler, led through two filters to retain the dust, and then passed through the drier to retain the moisture. The gases, perfectly clean and dry, enter the weighing globe 18. The CO_2 being 50 per cent. heavier than atmospheric air, fills, mixed with the gases, the inside of this globe. The heavier its contents, the more it is lowered and the more the balance indicates. The gases enter by inlet pipe 23 and 19, and are drawn out by 22 to the chimney. The chimney suction increased by an aspirator 67 draws the gases continuously from the boiler. The Econometer is fitted in plain view of the stoker on a cool wall or board in order to cool the gases down to atmospheric temperature. The inside of the Econometer case is constantly supplied with sufficient air through air inlet 56 to be able to weigh CO_2 in air. This is also drawn off to the chimney through cup 21.

In practice proper firing means from 12 to 15 per cent. of carbonic acid in the combustion gases. A sur-

plus of air would be shown by lower readings. Thus the stoker is enabled by proper attention and regulation of the damper to get the best possible results from the fuel.

The services of Mr. Robert Jamieson, formerly engineer in charge of the Lilloet, Fraser River & Caribou Gold Fields Co., Limited, have been secured to supervise the entire undertaking, and his wide experience in mining engineering work of all kinds will insure the most efficient working out of all the detail appliances necessary to apply the electric power in the most satisfactory manner for mining work.

Some interesting details as to the electrical features of the scheme have been made known. The apparatus, which will be furnished by the Canadian General Elec-

tric Company, Limited, will be of the three-phase alternating type, similar to that now being installed in the large power plant of the Lachine Rapids Hydraulic & Land Company at Montreal. The initial generating plant will consist of two machines, of the revolving field and stationary armature type, having a capacity of 1,000 horse power each, from which the current will pass through step-up transformers, raising it to 20,000 volts, the highest pressure as yet used on any electric transmission line. At this high pressure the energy will be carried to a sub-station at Rossland, a distance of thirty miles, where it will be reduced to a pressure of 2,000 volts, for transmission to the motors used in connection with the different mining operations.

The electric power will be furnished for operating tramways, hoists, pumps, ventilators, stamp mills, compressors, drills, etc., and will be sold at a price which, in comparison with the present high cost of power generated from coal, means a greatly reduced expenditure in this direction by the different mining companies. The machinery is now in the course of construction and the plant is to be in full operation early in the fall.

TORONTO TECHNICAL SCHOOL EXAMINATIONS.

As announced in our May issue, we publish below the answers to the Technical School examination questions in Electrical Engineering and Steam and the Steam Engine, as furnished by Mr. James Milne, lecturer in these subjects. The working of the problems in Electrical Engineering is shown in full, but in the case of Steam only the answers are given. Should any of our readers desire to see the working out of some of the most difficult of the questions we will be pleased to publish the same for our August issue. For the questions in Steam and the Steam Engine readers are referred to the May number of the ELECTRICAL NEWS.

ELECTRICAL ENGINEERING.

1. What data do you require for determining the amount of current as measured by the Tangent or Sine galvanometer? Work out the formula, and make the necessary sketches to illustrate your answer.

ANSWER.—Let X Y represent the plane of the coil and needle lying in the magnetic meridian and suppose A O B to represent the direction the needle has assumed under the influence of the

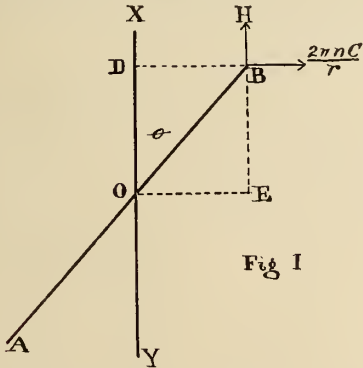


Fig 1

current. This direction will be the resultant of two forces, viz., the force $2\pi nC/r$ exerted by the current and the horizontal component of the earth's magnetism H . Since the needle is at rest the moments of these forces must be equal, i. e. $\frac{2\pi nC}{r} \times D O = H \times O E$ or $\frac{2\pi nC}{r} = H \cdot \frac{O E}{D O}$. But $O E = D B$ and $\frac{O E}{D O} = \frac{E B}{D O} = \tan \phi$, $\therefore 2\pi nC = H \tan \phi$.

The quantity $\frac{2\pi n}{r}$ is dependent on the form and size of the instrument. From the equation we see that the data necessary for determining the amount of current in the tangent galvanometer are

the values of n , r , H and the $\tan \phi$. Where $n = \text{No. of turns of wire}$, $r = \text{radius of the coil}$, and $H = \text{the horizontal component}$. In Toronto its value is about .1664 C. G. S. units.

In the sine galvanometer, instead of measuring the deflection as in the above, the coil is turned round so as to follow the needle, which, of course, deflects it still further; the coil is therefore turned still further round until finally the plane of the coil and the direction of the needles are once more parallel. In Fig. 2 let X Y = the original position of the coil and needle in the magnetic meridian and A B

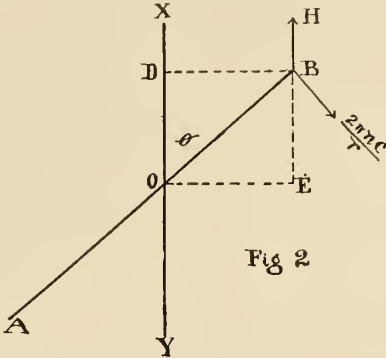


Fig 2

the final position of coil and needle. Then $2\pi nC/r$ will be the force tending to send needle at right angles to the plane of the coil, but H will tend to bring the needle back to the magnetic meridian. If the needle is at rest the moments about the centre O must be equal, i. e.:

$$\begin{aligned} \frac{2\pi nC}{r} \times B O &= H \cdot E O \\ \text{or } \frac{2\pi nC}{r} &= H \cdot \frac{E O}{B O}, \text{ but } \frac{E O}{B O} = \frac{D B}{B O} = \sin \phi \text{ of deflection} \\ \therefore \frac{2\pi nC}{r} &= H \sin \phi \\ \text{or C in C G S units} &= \frac{H \sin \phi r}{2\pi n} \end{aligned}$$

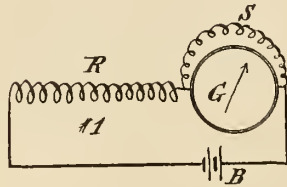
The data necessary being exactly the same as in the tangent galvanometer, the only exception being that the sin is substituted for the tan.

2. How would you determine the value of an unknown resistance if you were supplied with a Weston voltmeter, the resistance of which is known, together with a known E. M. F. and whatever wires, etc., are necessary for making the necessary connections? If voltmeter has 20,000 ohms R , and the E. M. F. is 600 volts, when the unknown R is put in circuit voltmeter shows 375 volts, what is the value of the resistance?

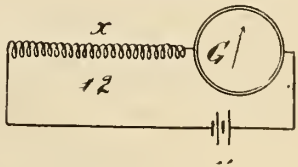
ANSWER.—Unknown resistance 6666.6 ohms.

3. With a shunted galvanometer, when a resistance of .1 megohm was in circuit, a deflection of 10° was observed when battery key was pressed. With same battery and shunt removed, there was a deflection of 5° when a certain resistance was in the circuit. Determine the value of the resistance. The resistance of the galvanometer was 7,920 ohms, and the shunt was $1/99\text{th}$. Omit in the calculation the battery resistance. Make a sketch of the arrangement, and show clearly how you arrive at your results.

ANSWER.—



$R = .1 \text{ meg.}$
 $G = 7,920 \text{ ohms.}$
 $S = 1/99\text{th.}$
 $d_1 = 10^\circ.$
 $B = \text{Resistance of battery.}$



$X = \text{Unknown resistance.}$
 $G = 7,920 \text{ ohms.}$
 $d_2 = 5^\circ.$
 $B = \text{Battery R.}$

$$\begin{aligned} C &= \frac{E}{R} = \frac{E}{R + \frac{G \cdot S}{G + S} + B} = k d_1 \frac{G + S}{S} \\ E &= \left(R + \frac{G \cdot S}{G + S} + B \right) k d_1 \frac{G + S}{S} \quad (1) \end{aligned}$$

Without shunt we get

$$\begin{aligned} C &= \frac{E}{X + G + B} = k d_2 \\ E &= (X + G + B) k d_2 \quad (2) \end{aligned}$$

as E is the same in equation (1) as in (2) then

$$(X + G + B) k d_2 = \left(R + \frac{G S}{G + S} + B \right) k d_1 \frac{S}{G + S}$$

omitting B which is very small and cancelling k

$$(X + G) d_2 = \left(R + \frac{G S}{G + S} \right) d_1 \frac{G + S}{S}$$

$$\therefore X = \left\{ \left(R + \frac{G S}{G + S} \right) d_1 \frac{G + S}{S} \right\} \frac{S}{d_2} - G$$

and substituting the values as given above we get

$$X = 20,007,920 \text{ ohms or } 20 \text{ megs. fully.}$$

4. The electro-chemical equivalent of zinc is .00034. What do you understand by this? What would be the deposit in an Edison chemical meter, the German silver shunt having a resistance of .01 ohms, and the resistance of the voltmeter and the coil in series with it being 48.96 ohms, when a current of 100 amperes has been passing for 4 hours. Make a diagram showing the arrangement.

ANSWER.—One coulomb deposits .00034 grams, = electro chemical equivalent.

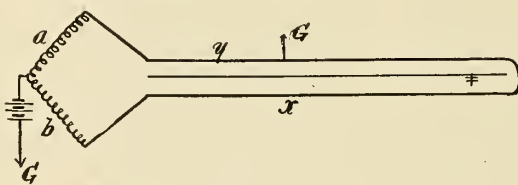
$\therefore$ Amount of current $\times$ electro chem. equivalent $\times$ time in seconds = deposit.

In the question the resistances are as .01 : 48.96

$\therefore 1/4897$ of $400 \times .00034 \times 3600 = 100$ milligrams will be the deposit.

5. In an Edison underground 3-wire system, the distance from power-house to feeder junction box is 6,000 feet. The copper resistance is .017 ohms per 1,000 feet. The two outside wires are looped together at one end (the junction box), and at the other the ends of the loop are attached to the terminals of the galvanometer. A 150-ohm resistance coil of 200 turns is also connected to the terminals of the galvanometer, and at a distance of 20 turns from one end one pole of a 4-cell battery is attached, the other pole being attached to ground. In this position there is no deflection of the needle. Find the location of the fault and give distance in feet from the power house.

ANSWER.—



$$a = 15 \text{ ohms.}$$

$$b = 135 \text{ ohms.}$$

$$l = \text{total length } x + y = .2040 \text{ ohms.}$$

$$x = l - y.$$

$$a x = b y.$$

$$a (l - y) = b y.$$

$$a l = y (a + b).$$

$$y = \frac{a l}{a + b} = .0204 \text{ ohms or } 1200 \text{ feet.}$$

6. What is the size of the conductor in the above question?

ANSWER.—Knowing that the resistance of one mil foot is 10.4 ohms we can easily find the diameter in mils.

$$\text{or } d = \sqrt{611,750} = 782 \text{ mils or } .782'' \text{ diameter.}$$

7. What data would you require to determine the permeability of an electro-magnet core which lifts a weight P pounds? Investigate a formula. What do you understand by permeability?

ANSWER.—The lifting power of a magnet in dynes is $\frac{B^2 A}{8\pi}$ where B = induction per square centimeter and A = area in square centimeters, from which we can easily get

$$B'' = \frac{\sqrt{\text{pull in lbs.}}}{\text{area in square inches}} \times 8494 \quad (1)$$

when B'' is = lines of force per square inch.

The law of the magnetic circuit being

$$\text{magnetic flux} = N = \frac{\text{Magneto motive force}}{\text{Reluctance}} = \frac{4\pi \text{ Amp. turns}}{\frac{10}{\Lambda u}}$$

$$= \frac{4\pi \text{ Amp. turns} \times \Lambda u}{10} \text{ for centimeter measurement,}$$

from which we get

$$N = \frac{3.2 \text{ amp. turns} \times \Lambda'' u}{l''} \text{ for inch measurement}$$

when Λ'' = area in square inches.

l'' = length in inches.

u = permeability.

$$\frac{N}{\Lambda''} = B'' = \frac{3.2 \text{ amp. turns} \times u}{l''}$$

$$\text{But in (1) } B = \sqrt{\frac{\text{lbs.}}{\text{area}}} \times 8494$$

$$\therefore \frac{3.2 \text{ amp turns} \times u}{l''} = \sqrt{\frac{\text{lbs.}}{\text{area}}} \times 8494$$

from which we get

$$u = \sqrt{\frac{\text{lbs.}}{\text{area}}} \times \frac{l''}{\text{amp. turns}} \times 2660$$

From this equation we see that the data necessary for determining the permeability, u , the specific conductivity for magnetic lines or multiplying power of the material which lifts a weight of P lbs. will be the following: The area in square inches of the magnet, the length of the core in inches and the number of ampere turns.

8. A current of 20 amperes, flowing through a resistance of 10 ohms, heats 20 lbs. of water from 60° to 70° Fah. How long was current flowing, supposing there was no loss by radiation?

ANSWER.—Let J = Joules mechanical equivalent.

H = No. of heat units.

1 lb. deg. Fah. = 1047.3 watts.

J H = Work done = $C^2 R t$

where t = time in seconds

$$\therefore t = \frac{J H}{C^2 R} = \frac{1047.3 \times 20 (70 - 60)}{20 + 20 + 10}$$

$$= 52.4 \text{ seconds nearly.}$$

9. What is the efficiency of an electric motor when running up to its maximum? Prove it.

ANSWER.—When motor is standing still the current that will flow through the winding will be $\frac{E}{R}$ where E = E M F of supply and when running

$$C = \frac{E - \text{counter E M F}}{R}$$

Useful work = $C \times \text{counter E M F} = \text{counter E M F} \left(\frac{E - C \text{ E M F}}{R} \right)$

Work spent in heating the conductors = $C^2 R$

Total watts = $E C = C^2 R + C \times \text{counter E M F}$

$$= C^2 R + \text{counter E M F} \left(\frac{E - C \text{ E M F}}{R} \right)$$

but $C^2 R = C \times \text{counter E M F}$

$$\therefore E C = 2 C^2 R$$

$$E = C_2 R$$

$$C = \frac{E}{2 R}$$

which shows that one-half the total power supplied is spent in heating the wires, and that the mechanical work given out by the motor is a maximum when the current is reduced to one-half the strength it would be if the motor was standing, and its efficiency is therefore $\frac{1}{2}$ or 50%.

10. Describe the Aron or Thomson wattmeter.

ANSWER.—The Thomson wattmeter is sufficiently well known that no description here is necessary. The following may prove interesting to some regarding the Aron meter.

Let E = E M F at service

C = current

T = term of one oscillation of correct clock

T = " " " " "retarded"

g = gravity

C. E. H = magnetic force

l = length of pendulum

$$T = \pi \sqrt{\frac{l}{g}} \quad T_1 = \pi \sqrt{\frac{l}{g - C. E. H}}$$

$$\frac{T}{T_1} = \frac{\pi \sqrt{\frac{l}{g}}}{\pi \sqrt{\frac{l}{g - C. E. H}}} = \frac{\sqrt{\frac{l}{g}}}{\sqrt{\frac{l}{g - C. E. H}}}$$

$$\left(\frac{T}{T_1} \right)^2 = \frac{1}{\frac{g}{g - C. E. H}} = \frac{1 (g - C. E. H.)}{1 g}$$

$$\left(\frac{T}{T_1} \right)^2 = \frac{1 - C. E. H.}{g} \text{ or } \frac{T}{T_1} = \sqrt{1 - \frac{C. E. H.}{g}}$$

So that this meter will record accurately the magnetic force, which should be very small compared with gravity, therefore $\frac{C. E. H.}{g}$ must also be very small compared with unity.

$$\therefore \left(1 - \frac{C. E. H.}{g} \right)^{\frac{1}{2}} = \left(1 - \frac{C. E. H.}{2 g} \right) \text{ very nearly}$$

or $\frac{T}{T_1} = \frac{1 - C \cdot E \cdot H}{2g}$ nearly, or the rate of loss in the second clock equals $\frac{C \cdot E \cdot H}{2g}$ which is directly proportional to $C \times E$.

11. Make a diagram showing the connections in the Brush or Thomson-Houston arc dynamos. Make sufficient sketches to fully illustrate the changes that take place in one revolution. Also describe some form of regulator for arc machines.

ANS.—A detailed description of this is not necessary here.

12. What does the torque of a motor depend on? Prove your statement.

ANS.— $E \cdot X \cdot C = 2\pi n T \times 1.356$.

When T = torque in pound feet and the multiple 1.356 is to bring pound feet to watts.

But E is proportioned to the speed if the flux N is constant, or

$$E = \frac{n N c n}{10^8} \quad \text{where}$$

n = revs. per second. N = No. of conductors.

If we substitute this value of E in the first equation we get

$$\frac{n N c n}{10^8} \cdot C = 2\pi n T \times 1.356$$

$$\frac{N c n}{10^8} \cdot C = 2\pi T \times 1.356$$

$$T = \frac{N c \cdot n \cdot C}{10^8 \times 8.52}$$

Showing that the torque depends only on the current and the flux N .

13. What do you understand by the "Constant" of a galvanometer? What data do you require in determining it? Give an example and show clearly what is meant by it.

ANS.—Take the first sketch in question No. 3, together with the same data.

$$R = \text{Total Resistance} = (.1 \text{ meg} + \frac{G \cdot S}{G + S} + B)$$

$$= (100.000 + \frac{G \cdot S}{G + S} + B)$$

Galvanometer Constant = Degrees deflection $\times$ power of shunt $\times R$

$$= d^1 \left(\frac{G + S}{S} \right) R$$

$$= 10 \times (100.000 + \frac{7920 + 80}{8000} + B)$$

and if we assume $B = 200$

then Constant = 100,279,200 ohms

or Constant in megohms = 100.28.

This number represents the deflection that would be produced on the scale if there was 1 megohm in circuit, if no shunt was used; or if 1 ohm was in circuit there would be 100,280,000 degrees deflection.

Example showing the working after constant has been determined:

Cable 200 miles, deflection 100° , constant 100.28; what is the R ?

$$R \text{ of cable} = \frac{100.28}{d} = 1.0028 \text{ megs.}$$

Resistance per mile = 200.56 megs.

STEAM AND THE STEAM ENGINE.

ELEMENTARY.

- ANS. 1. 138960 ft. pds. 746215.2 ft. pds.
2. Cut-off $1/5$ th stroke. 16.1 lbs. M.E.P.
4. 17 in. diam.
5. 70 lbs. nearly.
6. 1571 sq. feet : 524 h.p.
8. (1) 1 : (2) 1.8 : (3) 2.7
10. $h = \frac{G}{4\pi^2 n^2} = 6$ in.
11. 68% lost.

ADVANCED.

12. $1\frac{1}{8}$ in. open to steam; full port opening to exhaust, the edge of the valve travelling $3/16$ in. past the edge of the post.

13. This was intended to be solved graphically, by Dr. Zeuners method. The accompanying diagram shows how the positions are arrived at, from which it is seen that the piston is $1/8$ in. from end of stroke when admission takes place; 18.4 in. at cut-off; 23 in. when exhaust opens and $4\frac{1}{8}$ in. at compression.

[The last part of the question has been omitted, as it will not affect the working. Further explanation to those desiring same will be freely given.—J. M.]

14. 23.45 I.H.P.; 18.57 B.H.P.; .79 efficiency.

15. 25.9 lbs. water.

17. 14.3 lbs. difference in M.E.P.

18. Would take too much space to answer.

19. Pitch = 2.186 in., 3.328 in. and 4.47 in. for single, double and triple rivetted joints respectively. Diam. of rivets 1.044 in. Strength of joints as compared with original plate = .52 for single, .69 for double, and .77 for triple rivetted joint.

20. 417 lbs. per sq. in. for longitudinal and 1534 lbs. per sq. in. for transverse seams.

21. As no tables are allowed at the examination the total heat must be calculated from the data given. Boiler efficiency .8; h.p. = 123; 10.6 lbs. equivalent evaporation; from and at 212 in.; 13.5% gain.

22. M.E.P. on high press. cyl. 60 lbs.; M.E.P. on intermed. cyl. 24 and 10 lbs. M.E.P. on the low press.; diam. of h.p. piston $29\frac{3}{8}$ in., intermediate $46\frac{1}{2}$ in., low press. 72 in.

23. 178 h.p.

QUESTIONS AND ANSWERS.

"SUBSCRIBER," Hull, Que., writes: What is the indicated horse power of an $8'' \times 10''$ non-condensing engine running 125 revolutions per minute, steam pressure at 100 lbs., cutting off at half stroke? Also what is the average pressure throughout the stroke?

ANSWER.—We will assume that the above pressure signifies gauge pressure, which gives us 115 lbs. absolute, and that the back pressure is 5 lbs. above atmosphere or 20 lbs. absolute, then the

Mean effective pressure =

Initial pressure $\left(\frac{1 + \text{hyp. log of } R}{R} \right)$ — back pressure

where R = Ratio of expansion =

$$\frac{\text{Length of stroke} + \text{clearance}}{\text{Distance travelled by piston before steam is cut off} + \text{clearance}}$$

or leaving clearance out of the calculation, we get

$$R = \frac{\text{Length of stroke}}{\text{Distance travelled by piston before steam is cut off}} = \frac{10''}{5''} = 2$$

$$\therefore \text{M.E.P.} = 115 \left(\frac{1 + .693}{2} \right) - 20 = 77.3475 \text{ lbs.}$$

To find the horse power

$$\text{H.P.} = \frac{2 R \cdot A \cdot P \cdot S}{33000}$$

Where R = Revs. per minute.

A = Area of piston in square inches.

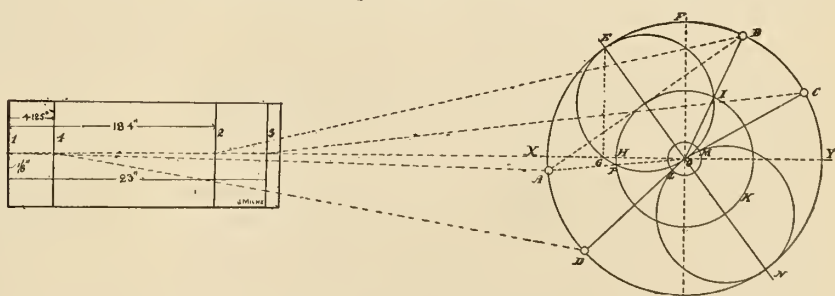
P = M.E.P. as found above.

S = Length of stroke in feet = $\frac{10}{12}$.

$$\text{or } \frac{2 \times 125 \times 50.26 \times 77.3475 \times 10}{33000 \times 12} = 24.54 \text{ h.p.}$$

"J. A. G.," Peterboro', Ont., asks: On a three-phase synchronous motor, carrying a standing load to increase the field current, thereby increasing the E. M. F., the current remaining the same, how is the increased energy accounted for, the speed remaining the same?

ANSWER.—If you really mean an "asynchronous" motor, then your question is impossible of answer. "Asynchronous" is the same practically as "induction" motor, which permits of no more field variation than



any other transformer, static or rotary. If, however, you mean "synchronous" motor, which is practically a generator used as a motor, then of course you know that the fields are separately excited, and only the armature coils supplied by the line currents. In this case the synchronous motor will produce a counter E.M.F. like in any D. C. motor, which counter E.M.F. may be made less or greater than the impressed line E.M.F. by varying the exciting field current. This back E.M.F. may be made to take the place of a negative reactance, having a condenser effect, and tending to produce a leading current, which, however, being wattless, takes no energy. This is probably what you want to know.

APPLIED MECHANICS.

THE following is a copy of the examination paper in Applied Mechanics submitted to the students of the Toronto Technical School at the closing of the 1896-97 term. Solutions of the questions, as worked out by the examiner, Mr. James Milne, will be given in our August issue:

ELEMENTARY.

1. State the principle of a lever, and prove it when P and W act on opposite sides of the fulcrum. A weight of 5 lbs. is hung at one end of a uniform bar, which is balanced over a knife edge at a point of 14 in. from the end at which the weight hangs. If the bar weighs 30 lbs., find its length.
 2. Define kinetic energy. How does it differ from potential energy? If a velocity of 300 feet per second is impressed upon a weight of 10 lbs., what is the measure of the energy now imparted to the weight?
 3. What is the modulus of elasticity of a substance? A round bar of iron, 12 feet long and $1\frac{1}{2}$ square inches in area, is held at one end, and pulled by a force till it stretches $\frac{1}{8}$ in. Find the force, the modulus of elasticity being 30,000,000.
 4. What do you understand by the efficiency of a machine, and how is it measured? In a single purchase crab, the pinion has 12 teeth and the wheel 78 teeth, the diameter of the barrel being 7 inches and the length of the lever handle 14 inches. It is found that the application of a force of 15 lbs. at the end of the handle suffices to raise a weight of 280 lbs. Find the efficiency of the machine.
 5. A cubical box or tank with a closed lid, the length of a side being 4 feet, rests with its base horizontal, and an open vertical pipe enters one of its sides by an elbow. The tank is full of water, and the pipe contains water to a height of 1 foot above the top of the tank. What are the pressures on the top, bottom and sides of the tank?
 6. A beam of timber rectangular in transverse section is 2 in. broad, 3 in. deep, and 4 ft. long, and rests upon supports at its ends. The breaking load at its centre is 2,000 lbs. What would be the breaking weight if the beam had been 4 in. deep, 2 in. broad, and 4 ft. between supports, but loaded at a distance of 1 ft. from the end?
 7. What is the "pitch" of a tooth of a spur wheel? Two parallel shafts whose axes are to be as nearly as possible 2 ft. 6 in. apart, are to be connected by a pair of spur wheels, so that while the driver runs at 100 revolutions per minute, the follower is required to run at 25 revolutions per minute. Calculate the diameters of the wheels, and, supposing the pitch to be $1\frac{1}{4}$ inches, ascertain the number of teeth in each wheel.
 8. A uniform beam weighing 1 ton rests on supports at its ends 20 feet apart. Weights, 5, 10 and 15 cwt., rest on the beam at a distance of 6 feet apart, and the weight of 5 cwt. being 4 feet from one end, and the 15 cwt. 4 feet from the other. Find the reactions at the supports and the centre of gravity.
 9. A safety valve 3 in. diameter; steam pressure 80 lbs. per square inch; from fulcrum to centre of valve 3 in.; lever 30 in. long, and weighs 10 lbs.; centre of gravity of lever 10 in. from fulcrum; weight of valve 3 lbs. What weight is required at end of lever so that steam will just blow off?
 10. Friction being neglected, find the force which will support 1 ton on an incline of 1 foot vertical and 10 feet along the incline. If the incline were 1 foot vertical and 280 feet along the incline, find the force in lbs. that would support 1 ton.
 11. The accumulated work of one pound of gunpowder is 70 foot tons. Find the amount necessary to project a shot of 5 cwt. at a velocity of 1,000 feet per second. If the charge were 100 lbs., find the weight projected at the above velocity.
 12. A locomotive together with train weighs 100 tons and runs at the speed of 30 miles per hour on a level rail. Find the horse-power if friction is 8 lbs. per ton. If the rails had an incline of 1 per cent., what additional horse-power would be required?
- ADVANCED.
13. In a Weston pulley block the sheaves are 9 inches and $8\frac{1}{2}$ in. diameter. What weight could be lifted (neglecting friction) by a pull of 50 lbs. on the chain? Since in this block the weight remains suspended when there is no pull on the chain, what do you infer as to the limit of efficiency? How would you determine the actual efficiency of the apparatus?
 14. The foot of a uniform derrick pole weighing 2 cwt., rests on the ground, and the pole carries a weight of $1\frac{1}{2}$ tons suspended from its upper extremity. The length of the pole is 20 feet, and is kept in position by a guy rope fastened to the ground 10 feet to the rear of the foot of the pole, and 25 feet in length. Find by calculation the tension on the guy rope, and by construction the thrust on the jib.
 15. A wooden beam, 12 in. deep, 6 in. wide, and 12 ft. long, is imbedded in a wall at one end. What weight will the beam carry at the outer end, if the B. W. of a beam 1 ft. long, 1 in. x 1 in., supported at the ends and loaded at the centre, is 500 lbs.? What is the shearing force.
 16. The table of a drilling machine is raised and lowered by a single threaded worm and worm-wheel in combination with a rack and pinion. A pressure of 10 lbs. is applied at the end of the handle, which is 12 in. long. The worm-wheel has 24 teeth, and the rack pinion has a pitch circle of 2 in. radius. What weight placed on the table would be balanced under these conditions, supposing that 50 per cent. of the work applied is lost in friction, and that the table together with the moving attachments weigh 5 cwt.?
 17. Draw an isosceles triangle with the vertical angle at 120° , trisect the base, join the points of trisection with the vertex, and draw perpendiculars from the points of trisection upon the sides nearest to them.

Regard the figure as a roof truss with a load of 2,000 lbs. upon each rafter, whereof 1,000 lbs. is carried at the middle joint. Find, by calculation or otherwise, the stresses on the various members.

18. Determine the horse power which may be transmitted by a leather belt 36 in. wide and $\frac{3}{8}$ -in. thick, running at 80 ft. per second, the tension on the slack side being $\frac{4}{10}$ ths that on the tight side, and the maximum strength allowed 300 lbs. per square inch.

19. Taking the weight of a cubic foot of leather to be 60 lbs., determine the effects due to centrifugal force in the above question.

20. A shaft, having a stepped cone, revolves at a constant speed of 200 revolutions a minute, and is connected by means of a crossed belt. The diameter of the largest step is 14 inches. The driven shaft is required to run at speeds of 250, 175, 130 and 90 revolutions per minute. Determine the diameter of all remaining steps of the two cones, and also the length of the belt required if the distance between the centres of the shafts is 10 feet.

21. A uniform platform A B, weighing 3 cwt., is supported at B by a hinge. At A a 20 foot chain is attached and hung from a hook vertically above B. A weight of 10 cwt. is placed 2 feet from A. If the distance A B is 12 feet, find the tension of the chain and the direction and magnitude of the reaction at the hinge.

22. In an epicyclic train consisting of three wheels, the first is a dead one, consisting of 60 teeth, and the second has 30 teeth, and the third 40 teeth. Ascertain the number of revolutions the second and third wheels make for each revolution of the arm, together with the direction of same relative to the arm. If the wheel of 60 teeth makes 2 revolutions in the same time as the arm makes 1 revolution, but in the opposite direction, determine the number of revolutions of the second and third wheels.

23. A locomotive weighs 45 tons, and one-third of this weight rests on the driving-wheels. The co-efficient of friction being $\frac{1}{175}$ between the wheels and the rail, what load will the engine draw on the level if co-efficient of traction be 8 lbs. per ton? What load would the engine draw up a 4 per cent. grade at the same speed?

24. The diameter of a fly wheel is 20 feet; depth of rim 12 in.; width of rim 18 in. Running at 80 revolutions per minute. Find the centrifugal force and bursting stress. A cubic foot of cast-iron weighs 450 lbs. Take the radius of gyration as being 9.5 feet.

25. What would be the maximum number of revolutions the above wheel could make per minute, taking the tensile strength of good cast-iron as being 20,000 lbs. per square inch.

PATENTS FOR ELECTRICAL DEVICES.

PATENTS have been granted in Canada for the following devices: Canadian General Electric Co., Toronto, electric circuit controller; W. W. Jacques, Newton, Mass., electric power converter; M. Rangey and Peter Plante, Schenectady, N. Y., trolley switch; W. J. Greene, Cedar Rapids, Iowa, automatic cut-out for electrical transmission; Canadian General Electric Co., Toronto, regulator for alternating current circuits; Bell Telephone Co., telephone circuit; G. L. Campbell, Kinsman, Ont., dynamo electric machine; H. A. Parrish, Jackson, Mich., electric trolley signals for railways; Wm. Rosco Smith, Manchester, N. H., electric heating apparatus; Canadian General Electric Co., Toronto, electric brake; Fred. Green, Hull, Que., electrical thermostat; J. J. Teetzel, St. Thomas, Ont., air brake; G. J. Scott and W. S. Janney, Pennsylvania, system of electric distribution; J. A. Gowans, J. S. Fuller and M. Macfarlane, Stratford, Ont., electric annunciator.

CORRECTION.

IN connection with the new schedule of rates adopted by the Inland Revenue department for the inspection of electric light meters, and published in our last issue, a light was said to mean a 16 candle-power lamp 'consuming electrical energy at the rate of 15 watts. This should have been 55 watts.

WANTS IT OFTENER.

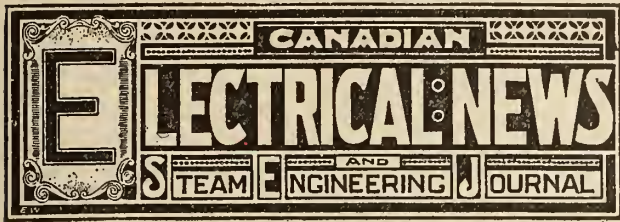
MR. Chas. E. Taylor, Sault St. Marie, Ont., in renewing his subscription to THE NEWS, writes: "Switch it in again; I hope soon to see it twice a month."

Is your piston rod in line, or are you a good customer for the packing man?

Are your belts running with as little tension as possible, and thus avoiding excessive friction?

It is a good idea to be as economical as possible in the use of oil, but it does not pay to attempt to run an engine with an insufficient quantity of cylinder oil, for not only will the cylinder be ruined, but you will use extra oil enough to much more than pay for all the cylinder oil needed.

Paper telegraph poles are the latest development in the art of making paper useful. These poles are made of paper pulp, in which borax, tallow, etc., are mixed in small quantities. The paper poles are said to be lighter and stronger than those of wood, and to be unaffected by sun, rain, dampness, or any of the other causes which shorten the life of a wooden pile.



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Regulating Devices for Light and Power. STEAM engines with automatic variable cut-offs were the outcome of a demand for constant speed of rotation to be maintained on shafting driving fluctuating loads; and high speed, automatic cut-off engines were more especially the outcome of a demand for a prime mover to actuate high speed electrical machinery without countershafting. But, because automatic cut-off engines were specially designed for use in electric service is no reason why they should invariably be used, without reference to the conditions of a particular case, unless those conditions are such as to call for them. As automatic cut-offs were designed to meet the conditions imposed by a rapidly fluctuating load, where the load is practically constant, as in most smaller central stations on their arc systems, it will be evident that a less expensive and complicated type of engine will suffice. Even in incandescent systems a little observation will show the engineer at which time he may expect an increase in his load, and he can then meet it by opening the throttle a little wider. In a lighting plant, although, of course, the load varies greatly between the early part of the night and the morning hours, still the variations are not of the character of fluctuations in a railway plant, but a gradual increase and decrease which may be accurately predicted and thus allowed for. On an arc load this variation almost entirely disappears, and therefore the necessity for any close regulation. What is really required is a good constant steam pressure, and then any good engine may be expected to give satisfactory service without expensive centrifugal speed regulating devices. Similarly with compounding devices for generators, it is often claimed that a generator so wound as to over-compound to some definite percentage at full load is so much a better machine for central station use as to justify a great increase of price over that of a machine the pressure of which can be regulated only by hand. Where the load rapidly fluctuates up and down, as in a railway plant, this is quite

reasonable, but in a purely lighting plant, where it increases and decreases slowly and regularly, the necessary voltage adjustments can be made by hand quite satisfactorily. It is a great mistake to base the details of any new plant merely on conventional practice, without regard to special conditions which are presented by everyone; the more carefully any case is studied the greater is likely to be the economy in first cost, and in subsequent operation.

Efficiency of Transformers.

FOLLOWING our remarks in last month's issue on the subject of transformer losses, we have seen results of a test recently made by an unbiased engineer on a number of transformers of Canadian make. They were all new, and of sizes varying from 1,250 watts to 5,000 watts. Between the best and the worst of the former size there was found a difference of 34.1 watts of core losses; between the best and worst of the 2,500 watt size there was a difference of 60 watts core loss; between the best and worst of the 5,000 watts a difference of 16 watts core loss and 37 watts copper loss. These losses mean coal wasted, and placed on a reasonable basis show that the transformers with the lower losses in the above cases were worth more as investments than the others by \$25, \$35, and \$15.25, for the respective sizes as above; that is to say, that the better transformers at \$50, \$70, and \$30.50 were just as good investments as the worst at \$25, \$35, and \$15.25, and at any lower prices were distinctly better investments. This is not a supposition case, but an actual occurrence, and should be an object lesson of great value to the large class of purchasers who are guided by price more than intrinsic value. We quote from a report of Prof. Jackson, who after giving a table of such core losses, etc., as may reasonably be allowed on transformers of various wattages, says, "The guarantees outlined may be easily met by any transformer manufacturer who builds safe and economical transformers, and they are now met by a number of makers. Transformers that do not meet the insulation and heating guarantees are unsafe to use upon commercial electric lighting or motor circuits, while those that do not meet the iron loss, regulation, and exciting current guarantees waste the company's money."

Merits of Transmission Systems.

AT a time when the long distance transmission of power by electrical means is being very eagerly discussed, and attention drawn towards the various polyphasic systems as rendering such possible, one is rather apt to be carried away by the enthusiasm of the moment and believe that only by the use of high voltage polyphase currents is it practicable to transmit over great distances with a reasonable expenditure. It is, however, not only interesting but also instructive to observe that in Europe, where, as is admitted by unprejudiced American engineers, engineering is more thorough and probably better than on this side of the Atlantic, a considerable number of quite important transmission enterprises have adopted the continuous current series system; placing as many separate machines in series as may be necessary to generate a high difference of potential, which in some cases has been so great as 14,000 volts, used with success. The series system is, of course, adopted throughout, necessarily, all motors being also in series on the same circuit as the generators. Constant

current series machines are now being built both in Europe and America of very much larger size than was considered possible a few years ago; five years ago a 50-light arc machine was thought to be the limit—generating a difference of pressure of about 2,500 volts; now the most prominent makers guarantee machines with a capacity of 125 lights, or 6,250 volts. There are no doubt certain grave objections to the series method of transmission, but, as compared with the high voltage, polyphase alternating method, it presents some evident advantages. The disadvantages may be said to be the necessity of generating at once the full pressure used on the system, instead of being able to generate a low one on the machines, which can be raised by means of step-up transformers; the impossibility of using the simple induction motor; and the necessarily more complex current and speed regulating devices for both generators and motors. Against these may be placed the higher resultant efficiency of the total series plant as compared with the resultant efficiency of an alternative system, by the elimination of all losses due to capacity and inductance in the transmission wires, and those due to hysteresis, and lag in both transformers and induction motors. The difficulty of constructing continuous current machines for such high voltage is overcome by first-class methods and materials, and the entire practicability of this method of transmission seems to be vouched for by the fact that for four years it has been in continuous operation under a pressure of 3,500 volts per machine, and that quantities of power up to 1,200 h.p. are daily being transmitted over distances up to 20 miles, in Switzerland, Hungary and France, and are being utilized freely and satisfactorily in units so small as 2 h.p. We shall hope to see this system introduced shortly into Canada, where we have so many large water powers.

CONGRATULATIONS TO MR. FREDERIC NICHOLLS.

THE recent meeting of the National Electric Light Association of the United States held at Niagara Falls, N. Y., is unanimously considered by the electrical press, voicing the sentiments of those in attendance, to have been the most successful from all points of view in the history of the Association. The credit for this successful meeting, as well as for the excellent work done by the Association during the current year, is evidently regarded as being in a very large measure due to the work of the President, Mr. Frederic Nicholls, general manager of the Canadian General Electric Co., as the following resolution clearly shows:

At the twentieth Convention of The National Electric Light Association, held at Niagara Falls, New York, June 10th, 1897, the following preambles and resolutions were unanimously adopted:—

Whereas The National Electric Light Association has during the past year, and at this its twentieth convention, achieved unequalled success, it is hereby resolved—That the congratulations of the Association be and are hereby extended to Mr. Frederic Nicholls, its President for this year, upon the brilliant results attending his administration of its affairs.

Resolved, that Mr. Nicholls be complimented especially upon the exemplary zeal and untiring energy with which he sought and found opportunities for the Association's greater usefulness, and made the organization more than ever a power for good in the light and power industry, and among the local central stations of the country.

Resolved, that in particular Mr. Nicholls be felicitated upon the cheering triumph, during his memorable term of office, of the Association's long continued endeavor to secure an authoritative

national code of wiring rules, upon the movement to standardize incandescent lamps, and upon the remarkable stability in funds and membership with which his period of presidential service closed.

Resolved, that these expressions of heartiest esteem and goodwill towards one for so many years an official of the Association be appropriately engrossed and presented by the Secretary to Mr. Nicholls.

(Signed) SAMUEL INSULL, President.
(Signed) GEO. F. PORTER, Secretary.

TEST OF THE TORONTO RAILWAY COMPANY'S BOILERS.

THE accompanying table gives the results of a set of tests made by Mr. George H. Barrus, of Boston, on the boilers of the Toronto Railway Company's plant, to determine the economy due to the use of Green's economiser.

This plant embraces six boilers of the Scotch marine type, the dimensions of which are 10 ft. in diameter and 14 ft. in length. Each boiler is fitted with Fox corrugated furnaces, provided with grates 6 ft. long and 3 ft. wide, and each has 80 4-in. tubes running from end to end. The area of grate surface in each boiler is 86 sq. ft., about 40 per cent. of which is air-space, and the area of heating surface is approximately 1,500 sq. ft. The whole plant of six boilers has 216 sq. ft. of grate surface, and approximately 9,000 sq. ft. of heating surface. Steam is used by a number of engines which furnish power for generating the electric current used by the railway. The plant is in operation, under its normal conditions of work, for a period of about 18½ hours each day. During this period the average amount of current generated is some 2,400 amperes, at a pressure of 550 volts. For the remaining period of 5½ hours the load ranges from 80 to 280 amperes, one of the smaller engines being in use during the greater portion of this time. During the night period two of the boilers are kept in continuous operation, but the fires in the remaining boilers are banked. At the time of the tests all the six boilers were in operation, and the fuel used was a mixture of Pittsburg slack coal and pea and dust anthracite from the mine, in the proportions of two loads of the former to one of the latter. The fires were cleaned three times during the full run of 24 hours. At times of the heaviest load the plant required the assistance of some of the old boilers of the station.

The fuel used on the tests was that commonly burned, that is, a mixture of Pittsburg slack and pea and dust from the mine. The proportions were approximately 66.5 per cent. of the former and 33.5 per cent. of the latter on both tests. The calorific value of a sample of this coal, as determined in Barrus's calorimeter, is 13,121 B.T.U. per pound of coal, and 14,875 B.T.U. per pound of combustible, the ash being 11.8 per cent. The spreading system of firing was employed, the thickness of the bed of coal being about 6 in., and the fires were frequently broken up and levelled off. During the progress of the tests the regulating damper in the main flue was constantly wide open, and at both tests the boilers were run at practically full capacity.

On the test with the economiser in use 6,510 lbs. of coal were used by the old boilers, and on the test without the economiser 20,390 lbs. The water supplied to the old boilers was not measured. These boilers have no connection with the economiser, and consequently their work had no direct bearing upon the main test. The coal which they consumed, here noted, is in addition to that recorded in the table. The saving due to

the economiser is shown to represent 18.3 per cent. of the coal required when the economiser was not in use, and amounted for a day's run to 21,385 lbs., or 10.7 tons of coal. The efficiency of the plant or the percentage which the heat utilized bears to the calorific value of the coal when the economiser was in use, was 70.6 per cent. It may be added here that the maximum temperature of the water leaving the economiser during the trial was 253 degrees.

DATA AND RESULTS OF EVAPORATIVE TESTS ON TORONTO RAILWAY COMPANY'S BOILERS.

Conditions as to Running of Econo- miser.	Economiser running.	Economiser not running.
1. Duration.....hrs.	19.66	19.72
2. Weight of dry coal consumed...lb.	95,310	104,372
3. Weight of ashes and clinkers...lb.	14,417	15,932
4. Percentage of ashes and clink- ers.....per cent.	15.1	15.3
5. Weight of water evaporated....lb.	788,717	702,610
HOURLY QUANTITIES.		
6. Coal consumed per hour.....lb.	4,847.9	5,292.7
7. Coal per hour per square foot of grate.....lb.	22.4	24.5
8. Water evaporated per hour....lb.	40,113	35,634
9. Equivalent evaporation per hour, feed 100 deg., press. 70lb....lb.	40,435	36,602
10. Horse-power developed, A.S.M.E. basis of 30 lb.....h.p.	1,347.8	1,202
AVERAGES OF OBSERVATIONS, &C.		
11. Average boiler pressure.....lb.	120.3	119.3
12. Average temperature of feedwater at point of entering economiser deg.	101	96.4
13. Average temperature of feedwater at point of leaving economiser deg.	237	...
14. Average temperature of flue gases at point of entering economiser deg.	620	607
15. Average temperature of flue gases at point of leaving economiser deg.	293	...
16. Average draught suction in main flue near boilers.....in.	0.83	1.16
17. Weather and outside temperature {	Clear Moderate	Cloudy Moderate
RESULTS.		
18. Water evaporated per lb of coal..lb	8.275	6.731
19. Equivalent evaporation per lb. of coal from and at 212deg.....lb.	9.586	7.828
20. Equivalent evaporation per lb. of combustible from and at 212deg.lb	11.291	9.243
21. Weight of dry coal required to eva- porate 788,717lb. of water sup- plied at 101deg. (for 24 hours' run) based on above results.....lb.	95,310	116,695
22. Saving of coal due to economiser for 24 hours' run.....lb.	21,385	...
23. Percentage of saving due to econo- miser.....	18.3	...

NOTE.—The temperature of the flue gases here given does not include the night period from 12 midnight to 6 a.m.

PERSONAL.

Mr. Ormond Higman, Chief of the Electrical Inspection Department of the Dominion Government, returned last month from British Columbia and the Northwest Territories, having been absent several weeks. While there Mr. Higman established offices and appointed inspectors for these districts to inspect electric light meters, in accordance with the Electric Light Inspection Act. He advises us that the gas inspectors have been commissioned to act in this capacity, as was the case in the eastern provinces.

Mr. W. McLea Walbank, managing director of the Lachine Rapids Hydraulic & Land Co., has been elected a member of the executive committee of the National Electric Light Association of the United States. As the holding of the executive offices in the association is an honor very much sought after, the election of Mr. Walbank to the executive committee following the occupancy of the president's chair by Mr. Frederic Nicholls, is an appreciative recognition of the importance of Canadian electrical interests on the part of our American confreres.

WHY SOME LIGHTING PLANTS DO NOT PAY.

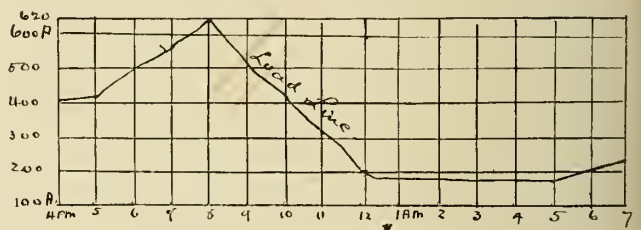
BY GEORGE WHITE-FRASER.

At the last convention of the Canadian Electrical Association there were some very valuable papers presented; valuable not only in themselves, but because of the discussions they gave rise to. Probably that one presenting features of most practical interest to central station owners was Mr. Armstrong's, on the above subject, and while necessarily limited to mere general indications as to the reasons for failure to produce dividends, many points were made of great importance. Mr. Armstrong, in his last paragraph, states that he had intended to take up the subject of "engineering and operation, taking up, first, the question of selection of apparatus, etc., and considering how far deviations from such an ideal installation were responsible for failure to get best results in a given case." Although this part of the subject seems thus to be considered of secondary importance, I think it really deserves to be placed before the other. I think it will be at once admitted that for each case there is a certain amount and combination of machinery, lines, etc., that will best and most efficiently perform the work, and that any deviation from this best combination will introduce an inefficiency into the working. It follows, therefore, that a poor, or even moderately injudicious design or combination, will impose on the plant an inefficiency that can never be overcome, even by the most intelligent, educated management. Once a plant is bought and installed, there's an end of it; it has got to be operated just as it is; and any little expense arising from the very many possible errors in design of a plant containing both the steam and electrical machinery will be a yearly loss just as long as the plant continues to operate in that state. You can engage an inexperienced engineer, and he can learn; you cannot teach machinery. In my experience, electric light and power plants in the Dominion are not designed at all, or if they have been, it has been by someone who has had machinery to sell, and who has therefore been more interested in selling a plant than in considering how it is going to operate afterwards. The consequence is that, I might really say, the majority (certainly the large majority of those I have seen), while having everything of good quality, good boilers, engines and shafting, good dynamos and lines, etc., regarded as electric lighting plants, and not merely as exhibitions of different kinds of machinery, are very ill adapted for economical operation under their local conditions.

Mr. Kammerer, in his very useful paper on "Day Loads," says truly that now-a-days a central station man when purchasing machinery asks, not "What is the price?" but "What is the efficiency?" This question itself indicates a very long stride forward; but let me suggest to central station men that the most vital question is not "How am I to get the most efficient machine?" but "How am I to get the most efficient plant?" The dynamo is not the only machine in a plant, and efficiency is a matter involving every apparatus from the boiler to the lamp. The highest "plant efficiency" is attained only when every piece of apparatus works harmoniously with the rest in attaining the object for which the plant was constructed, at the lowest possible cost. Regarded in this light, a dynamo may have a very high specific efficiency and yet be an important factor in producing a low "plant efficiency." This "plant efficiency" may be defined in various ways, such as (a) the proportion existing between the maximum capacity of the plant and the largest load it ever carries; or (b) the proportion between the actual kilowatt capacity for twenty-four hours and the largest kilowattage ever supplied during the same time; or (c) the proportion between the power equivalent of the combustible consumed under the boiler during one run and the electrical power actually delivered to the lines during the same time. None of these definitions include the plant efficiency of the lines and transformers, which, however, is also an important matter.

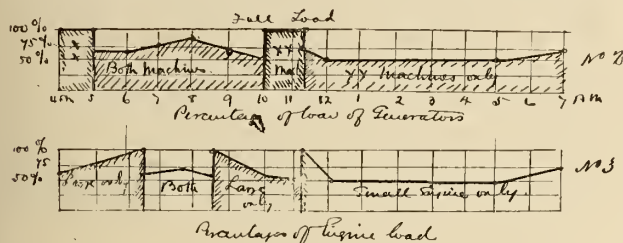
The first definition may seem to be rather unnecessary, in view of the probability that at least a man knows how much to buy, but a little consideration will show that a good many factors influence the decision of the proper-sized plant for certain conditions. For instance, the number and class of residences, stores, hotels, churches, etc., will be an approximate guide—taken in connection with the proposed rates—as to the total lighting that may ultimately be expected, and a very careful examination will very closely show what may be expected as the maximum load. Now, in both these estimates experience in the electric lighting business is necessary, and it is not business-like to buy machinery without having gone into them thoroughly. In one case that I have in mind, the ampere capacity of the plant was 750, and the heaviest momentary load at any time during the year was 620, and that lasted for just thirty minutes. It is evident that at no time was

the load more than 83 per cent. of the capacity, and anyone who has made out a load curve will see that the average load will be about half of this, or say 45 per cent. of capacity—and this for an average of about twelve hours during every twenty-four. In this case plant efficiency was low, and imposed a constant loss that the best operation in the world could not avoid, but that good preliminary engineering and design could and probably would have. It is not merely the unnecessary capacity of the dynamos alone; but the whole plant—engines, boilers, lines, etc.—were originally made too large. Inquiry elicited the facts that it was purchased and installed on the advice of the agents of the two manufacturing companies who supplied the engine and generators, etc. Definition (a) takes into consideration merely the actual total capacity of the plant, without reference to its division into units or to their arrangement. Definition (b) relates more specially to a plant where current is sold by meter; but (c) takes into account not only the total capacity, but also the manner in which this total is subdivided into units. This subdivision may seem a rather unimportant matter. To a person who operates an electric light and power plant as a business investment it is just as important as anything else; and the man who buys on efficiency rather than on price will admit the soundness of the claim, because it rests directly on machine efficiency. Illustrations from actual cases will have more point than purely theoretical discussion. Taking therefore the above case—the load line for the night that gave the highest maximum for the year was as in diagram. Maximum



620 amperes; minimum 160 amperes; and whereas the maximum was on for half an hour, the minimum was on for 5 hours. Is the subdivision into units of no importance in the above case? The minimum lasted one-third of the entire run, and was therefore an important consideration. The plant was a D.C. 3-wire one, divided into two 170 ampere machines, and two 200 ampere ones, with two long stroke engines of 120 and 65 h.p. at 80 lbs. steam, $\frac{1}{4}$ cut-off. The engines belted on to a shaft through clutch pulleys, and the shaft itself was divided in two by a clutch coupling. The engines were so arranged that the 65 h.p. drove that end of the shaft off which were belted the two 160 ampere dynamos, while the 120 h.p. belted on to the shaft driving the two 200 ampere machines; the clutch coupling of course permitted the running of the entire plant as one. The machines were over compounded 10%, giving 120 volts at full load. Now let us analyze the working of the station on the night of the given load line. From 4 p.m. to 5 p.m. there were about 400 amperes, just enough for the two 200 ampere machines, which we will designate XX, (the others being YY). The kilowattage therefore was 48,000—or 64 h.p. Allowing XX an efficiency of 90%, required nearly 71 h.p. to drive them, not taking two belt losses into account. This was closely the power of the 65 h.p. engine, but running this engine necessitated running the entire shaft, and the two empty YY dynamos. So that the 120 h.p. engine had to be used, and had to run on about 80 h.p. or 66% load—not very efficient. At 5 p.m. the load was above the capacity of the XX machines, so the YY's were thrown in as well, with a total combined capacity of 750 amperes. Thus from 5 p.m. to 10 p.m. the percentage of the load to the capacity of the machines varied gradually from 53% to 83%, and then back to 53% again. Looking at the engine plant during the same time; at 5 o'clock the 120 h.p. engine was running on about 65% load. When 550 amperes were reached, this engine was about properly loaded, counting dynamo efficiency at that point as 85%, and allowing for belts and shafting. At this point, therefore, the 65 h.p. engine had to be thrown in; so we now have engines to a capacity (economical) of 185 h.p. doing about 120 h.p., again 65%. From now—6.30 to 8.30 p.m.—the total load carried by the engine plant varies from 65% up to 73% and back to 65% again. From 8.30 (at which point the small engine is thrown out) to 10 p.m. the 120 h.p. engine runs on a percentage falling from about 100% down to 65%. Now returning to the generators—at 10 p.m. XX have a 100% load falling to about 75% at 11.15 p.m. There the YY machines are thrown in instead, with a load dropping from about 100% at 11.15 down to about 50% at midnight, which

percentage is kept for five hours, till 5 a.m., and then rises gradually to about 72%. During this period, from 10 p.m. down to about 11 p.m., the 120 h.p. engine must be run because the other would hardly have the power; it runs on a percentage of load falling from 65% down to about 58%. At about 11 p.m. the 65 h.p. will take care of the load and from now on to 7 a.m. it can run with percentage of load falling from about 100% down to 50% shortly after midnight, keeping it up till 5 a.m., and then gradually rising to about 75%. For clearness sake I give a diagram showing the percentage of full load at which the two parts of the plant operated, taken from the above figures; the percentage taken being that of the load at any moment relative to the full capacity of such machines as were actually used to give it.



A study of these diagrams will be interesting. Take No. 2. For just two hours during fifteen hours were any dynamos running at full load, and therefore at full efficiency. For about five hours the combined dynamo plant had an average of about 75% of full load, and therefore an efficiency of about 85%. For another five hours the YY dynamos had above 50% load, and an efficiency therefore of about 80%. Take diagram No. 3. During the whole fifteen hours' run, it will appear at a glance, that the steam plant was little more than half loaded. The efficiency of a steam plant is not very high under the most favorable circumstances; what it is under the conditions outlined I leave to each one to determine for himself. It may be thought that this is a special case selected as a horrible example. I beg to state that it is a very fair sample of the kind of engineering that results from the designing of power plants being left to those interested in the sale of machinery. I might give illustrations from a score of such plants in which the application of principles derived from the experience of electrical engineers would have had the most beneficial effects, if they had been applied to the preliminary engineering and design. There are some very obvious morals pointed by diagrams 2 and 3. About the most so is the advisability of designing a plant (both as regards steam and electrical machinery) with reference to the minimum load, quite as much as the maximum. Another is that the full load efficiency of machines is not of such great importance as the half load. Of course, in such a plant as the above, it is possible to improve matters by varying steam pressure in accordance with load, and allowing engines to work up to half stroke; but this will simply be an expedient, and what I particularly desire to point out is that preliminary engineering is of even more importance than good operation, because it depends on design whether the plant (not individual machines) will be efficient or not.

But, while preliminary engineering design has very great influence on subsequent economy of operation, the business policy outlined from the start has almost as great. This has to do with rates for lighting and power for the various different classes of consumers, rebates, lighting areas, method of collection, method of purchase of supplies, and many such points. It has always appeared to me that rates for incandescent lighting are capable of being greatly reduced. Instead of placing them at such figures as that even very small houses can take light, they are generally so high that only the best can afford it. I am quite convinced that in many plants a 20% cut in rates would be compensated for by a more than a counterbalancing rise in business; and in this I speak from experience derived from some plants that I am now managing. The rate question—and the other as to who is to do the wiring, the customer or the company—and some others can be altered from time to time; but the plant, once in, has got to stay. Mr. Armstrong says truly that "there is to-day no industry representing an equivalent money investment on a possibility of public service which is so generally managed by men who know nothing about it." The reason is not far to seek. The electric lighting industry is of comparatively recent date, and it is not such a very long time ago since first it began to be discovered that it was susceptible of being specialized. The growth and development of the business, and the competition of rival illuminants, has had the effect of evolving a new class of engineer—the central sta-

tion manager—and as time goes on and electric lighting business is better studied the new class of engineer will become a necessity, and investors will recognize his importance. The time is surely coming when central station owners will require some better qualification in their manager than the willingness to work for \$30 per month.

TRADE NOTES.

The Stevens Manufacturing Co., of London, Ont., have recently closed contracts for a 500 light plant for the town of Brussels, 500 light plant for Blyth, and 60 light arc plant for Lucknow.

Sadler & Haworth, belting manufacturers, of Montreal and Toronto, have just furnished the Hull & Aylmer Electric Railroad with two double leather main driving belts one hundred and thirty feet long and thirty-six inches wide.

The Robb Engineering Co. are building two 300 horse power tandem compound engines, one for the Halifax Electric Tramway Co., and the other for the St. John Railway Co. This makes five of these engines sold to the Halifax Company.

The Kay Electric Co., of Hamilton, have completed the installation of an electric light and ventilation plant for the Ontario Agricultural College, Guelph. This firm have also recently furnished a 15 h.p. motor for the Shipe Wood Rim Co., of Toronto, a 250 light generator for W. Davidson, and one for Donald Fraser, of Fredericton, as well as several motors for Ottawa and other eastern points.

The new lumber mills and grounds of Messrs. D. & J. Ritchie & Co., at Newcastle, N. B., have been equipped with an electric light plant by John Starr, Son & Co., Ltd., Halifax. The installation consists of about 200 incandescent lamps of 16 and 32 c.p., and by it the output of the mills will be much increased. Messrs. Starr make a specialty of installing electric plants in lumber factories, and many of these in Nova Scotia and New Brunswick have been equipped by them.

The Boiler Inspection and Insurance Company, of Toronto, have made a new departure, namely, the inspection of electrical dynamos and motors in Montreal. Mr. R. A. Ross has been retained as consulting engineer, and skilled inspectors will make periodical inspections and keep the machinery in proper running order. By this means the risk of having the power supply stopped is greatly lessened, while the annual cost of maintenance is a fixed sum and can be better provided for. The company anticipate considerable business in this direction.

The Packard Electric Co., of St. Catharines, Ont., were compelled to operate their factory day and night during the month of June in order to supply the demands of their customers for lamps and transformers for the Jubilee celebration, while many orders remained unfilled. It is learned that Packard lamps were exclusively used in the decorations at the Parliament Buildings at Ottawa. The new type "L" transformer was the one principally used for the above purpose. One unique feature of this transformer is that it requires but one cross-arm upon the pole, and does not require any separate hangers, the arrangement for hanging being permanently attached to the transformer.

The Goldie & McCulloch Co., of Galt, Ont., advise us that they have lately made the following sales of machinery:—Wm. Doherty & Co., Clinton, 100 h.p. "Wheelock" engine; Methodist Book & Publishing House, Toronto, 85 h.p. "Wheelock" engine, with shafting, pulleys, friction clutches and couplings; The C. P. R. Co., for elevator at Owen Sound, 400 h.p. "Wheelock" engine with two steel boilers, condenser and all connections; Jacob Zurbriigg, New Hamburg, 60 h.p. "Ideal" engine and boiler; Toronto Electric Motor Co., Toronto, 35 h.p. "Ideal" engine; Gravenhurst Sanitarium, Gravenhurst, 40 h.p. "Ideal" engine; McGill University, Montreal, 100 h.p. "Ideal" engine; Geo. Munro, Thamesville, 60 h.p. steel boiler; Wingham Electric Light Co., Wingham, 68 h.p. "Ideal" engine, with 75 h.p. boiler and all connections; Smuggler Gold Mining & Milling Co., Fairview, B. C., 25 h.p. engine and 30 h.p. boiler; Jolinson Electric Co., Toronto, 60 h.p. "Ideal" engine and boiler; New Hamburg Mfg. Co., New Hamburg, six locomotive fire box boilers; lot of milling machinery to Plattsville Milling Co., Plattsville; The R. Forbes Co., Hespeler, woollen mill machinery; S. Larue, Mountain, heading turner; Findlay Young, Killarney, Man., 85 h.p. "Wheelock" engine; Wm. Carey & Son, Windsor, N.S., lot of wood-working machinery; Wm. Mason & Son, Ottawa, wood-working machinery; Ferguson & Pattinson, Preston, six hydrants; The Tillson Co., Tilsonburg, flour mill machinery; Jas. A. Wilson, Cantley, Que., complete sawmill outfit, engine, boiler, sawmill machinery, and shafting; John Phillip, Grand Valley, 80 h.p. "Ideal" engine; Auld Bros., Shetland, a lot of mill machinery.

THE REVOLVING FIELD TYPE OF ALTERNATING CURRENT GENERATOR.

THE development of the revolving field type of alternating current generator, and the standardization of a complete line, both for the monocyclic and three-phase systems, has of late occupied the attention of the engineering department of the General Electric Company, with successful results. The alternators are designed for the standard frequency of 60 cycles, and for pressures ranging between 500 and 5,000 volts.

The machines are built on the same lines as the Canadian General Electric type of induction motor. The stationary armature is built up of laminations stamped from specially selected and tested steel plates. Ample spaces are left for ventilation, and the coils are covered and protected by shields. The base of the armature is of smooth cast-iron, and the pedestals supporting the bearings are provided with spherical seats, which support the boxes and allow of perfect alignment.

The removal bearings are, of course, self-oiling, with the oilways so cut as to give an even flow of oil from the resting places of the rings in the shaft to the end of the bearings where the oil returns to the reservoir.

The revolving field is extremely simple of construction. It is merely an iron spider mounted on a shaft carrying a soft-steel ring serving as a yoke for the pole pieces, which are made up of laminated iron with polar projections. The field coils are removable, and in the larger sizes are wound with flat copper strips placed edgewise, to allow of free egress from the coils of any

heat. The armature can be moved along the base to facilitate access to fields and armature winding.

With a high efficiency, these alternators combine good inherent regulation, and can be, if desired, compounded for accurate automatic regulation. Such compounding in certain cases is not necessary to convenient operation, and may be omitted. When compounded a commutator is mounted on the shaft and rectifies current supplied from a series transformer in the main circuit. These compounding devices are not, however, included in the generator, properly so called. They come under the head of extras. The temperature of the armature and the field windings does not rise above 45 degrees centigrade above that of the surrounding atmosphere.

The new type of generator is not, of course, intended to displace the revolving armature type. The revolving field type has its own special field of usefulness. It is free from high-potential collector rings and commutators, the only collector rings being the two used to bring the exciting current to the revolving fields. The high-potential part of the alternator—the armature—being a stationary structure, can be wound and insulated for much higher pressures than is desirable for revolving armatures, and the current can be fed directly into the line without the intermediary of step-up transformers.

All the high-potential terminals are effectually insulated.

The revolving field alternators can be wound for the two-phase system when desired, and when so wound are so arranged that armature coils can be cut in or out to give independent regulation of the two phases.

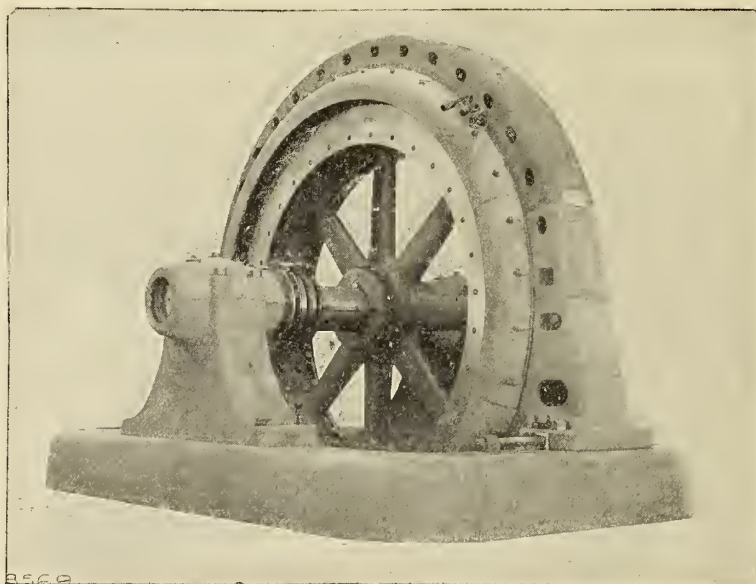
During the past year the Canadian General Electric Company has sold a number of machines of this type, some for belt drive, but principally for direct connection to water wheels. The illustration shows a 750-kilowatt, 40-pole, three-phase machine, running at 175 revolutions and delivering current at 4,400 volts. It is one of twelve which will be used on the Lachine Rapids installation.

Two more generators of the same type and size are now being constructed for the 30-mile transmission of the West Kootenay Power & Light Company. For very low potential work this type is especially well adapted, two of 150-kilowatt capacity each being in use at the Wilson Carbide Company's works at Merritton, Ont:

HOW MANCHESTER IS LIGHTED.

THE corporation of Manchester, England, owns and operates a large electric lighting system, which has

recently been fitted with the largest storage battery in the United Kingdom. It is not located in the central station where the current is generated, but about a mile distant, in a special sub-station. The current is distributed in Manchester by what is known as the five-wire system, a modification of the method followed by the Edison lighting companies in this country. The current as it is taken from the wires is of insufficient voltage to charge the



C. G. E. ALTERNATING GENERATOR, REVOLVING FIELD TYPE.

battery, and is accordingly transformed by a motor-generator to a current of 510 volts. The battery consists of 224 large cells, each containing 73 plates. The cells are made of heavy sheet lead, and are carried on iron and timber stands. The entire installation is divided into four distinct batteries of fifty-six cells each, coupled to the five-wire network of mains. Each of the batteries, thus formed is further subdivided into two parts, one consisting of the battery proper of forty-four cells, and the other a regulating battery of twelve cells. All the cells are placed in five arched vaults under a street, three of the vaults containing the main batteries, the fourth being used for the regulating cells, and the fifth holding the motor-generator and switchboard. The normal maximum rate of discharge of the plant is 600 amperes from each of the four batteries, or a total current of 2,400 amperes delivered at 100 volts to the mains. The average rate of discharge is 300 amperes, which is also the normal charging rate. The entire night load after midnight is taken by the cells, thus allowing a large reduction in the number of men employed from 10 o'clock in the evening until 6 on the following morning, while on Sundays relief is also given to the men working during the day, the battery taking the day-load up to 4 o'clock in the afternoon in addition to the load of the previous night.

ELECTRICAL DEVELOPMENT IN AUSTRALIA.

MR. J. S. Larke, of Sydney, N. S. W., writing to the Dominion government under date of April 10th, 1897, gives the following particulars of electrical matters in Australia :

ELECTRICAL WORK.

The railway construction branch of the Department of Public Works, of the government of this colony, will shortly complete plans and specifications for an electric street railway for this city.

The city of Sydney last year secured powers to effect a loan of a million and a half dollars to erect plant for lighting the city by electricity. Pending the conclusion of negotiations with the government respecting a common supply for lighting and street railways, nothing has been done in the matter. It is possible that within a short time tenders will be asked for both of these important works, and if Canadian electrical companies desire to compete it is advisable that they should watch for the advertisements. It is probable that the adventsirements will appear in London and this city at the same time, so that the London advertisements would be first seen in Canada. There will be, undoubtedly, an extension of electrical works in Australia, at a much more rapid rate than has hitherto been the case. Melbourne has a very effective cable system, but with that and another exception all the cities of the colonies are served by horse or steam lines or busses, when an electrical system would be preferable.

At the request of a Canadian company I have made inquiries into the consumption of carbons in these colonies, with the following result :—

CARBONS.

The total consumption of carbons in Australasia is estimated to be about three millions per annum. In New Zealand and Victoria electric lighting has made greater progress than in this colony.

No approximation of the sizes used can be given, but in the Railway Department of New South Wales the following are the sizes, number of each sort, and prices paid in 1896 :—

				s.	d.
Brockie-Pell,	9 in.,	13 mm.,	solid ; 12,000 per hundred...	3	10
"	15	15	cored ; 5,000 "	10	6
"	15	13	" 8,000 "	7	0
"	12	18	" 10,000 "	10	0
"	9	18	" 2,000 per hundred ft.	7	9
"	12	15	solid ; 4,000 "	8	0
"	9	15	" 5,000 "	6	6
"	15	18	cored ; 2,000 "	12	6

Brush, 12 in., 11 mm., solid, coppered, 12,000 per thousand feet, £3 7s 6d.

The thickness is given as in the case of all carbons here in millimetres. The Post Office Department uses 12 x 12 and 12 x 18, 13 x 9 and 13 x 15. As a rule the Post Office Department and electric light companies paid slightly higher rates than those paid by the Railway Department.

The following letter from the Department of Customs, Melbourne, gives the information respecting Victoria :—

"In reply to your enquiry of the 16th instant, relative to electric carbons, I beg to state that the quantity of goods imported is not available, the item being included under the heading of 'Electrical Goods.' Those used by the government of Victoria are all tendered for in the colony.

The Railway Department uses 11 millimetres solid and cored carbons, for which they pay under the present

contract, £2 per 1,000. Brush carbons the same size are also bought for £2 per 1,000, all of ten ampere currents.

The Postal Department uses the following under present contract :—

12 mm. carbons, cored, 12", 8,000 at £2 14 0 per 1,000.

12 mm. carbons, plain, 7", 2,333 at £2 14 0 per 1,000.

13 mm. carbons, cored, 15", 2,500 at £2 18 0 per 1,000.

19 mm. carbons, cored, 13", 1,083 at £2 18 0 per 1,000.

11 mm. carbons, plain, 12", 2,000 at £2 10 0 per 1,000.

9 mm. carbons, plain, 9", 750 at £1 10 0 per 1,000.

Those supplied at the Parliament House are the "Conradty," at £4 4s 0d per 1,000 ; size, 7/16 in. x 12 in. moulded.

The city corporation uses Fooke's and Hartmann's under the present contract ; size, 7/16 in. x 12 in. (11 mm.), the yearly estimate being 600,000 at £1 12s 10d per 1,000.

The estimated number used annually by the various government departments in Victoria and the city council is 750,000.

I think the demand for carbons will increase, but it is not doing so rapidly just now.

The carbons used here are mainly imported from Austria. United States makers have sent some here, but they have made no headway. The opinion seems to be that they are much higher in price and inferior in quality to the Austrian.

ANNUAL MEETING OF THE ROYAL ELECTRIC COMPANY.

THE Royal Electric Company held their annual meeting in Montreal on July 8th, at which the following directors were re-elected : Hon. J. R. Thibaudeau, president ; D. Morrice, vice-president ; F. L. Beique, A. Brunet, Allan Macdonnell, F. S. Holt, Edwin Hanson, J. A. L. Strathy, and Robert Cowans.

The annual report showed the revenue for the year to be \$900,348.10, and the expenditure for labor, materials, operation, maintenance and general expenses, \$656,467.99, leaving a gross profit of \$243,880.11. Deducting interest and fixed charges of \$43,245.83, left a net profit from business of \$200,634.24. From this net profit four quarterly dividends of 2 per cent. each were declared.

Additions and improvements to the factory and its equipment to the value of \$58,210.23 were made during the year, and on lighting stations, lines and installations and general construction the sum of \$99,880.30 had been expended for a like purpose. The total value of the additional equipment was thus \$158,090.53.

In connection with the placing of new generators and switchboards in the incandescent lighting station, a work completed in November last, it was noted that the saving in fuel resulting therefrom amounted to 4,015 tons.

During the Queen's Jubilee nearly 20,000 incandescent lights and about 200 arc lights were provided by the company in addition to the requirements of regular customers. During the month of April last arrangements were completed for placing the balance of the authorized capital stock of the company, namely, \$250,000 par value, in London, England.

DIRECT CURRENT MULTIPOLAR DYNAMO.

THE accompanying illustrations represent a new type of direct current multipolar dynamo, manufactured by the Electrical Construction Company, of London, Limited, and specially adapted for isolated lighting plants. Among other features the manufacturers claim for this machine the following points of merit:

A minimum number of parts are employed in its construction, and all the mechanical details are so perfect in design that absolute interchangeability of parts is obtained.

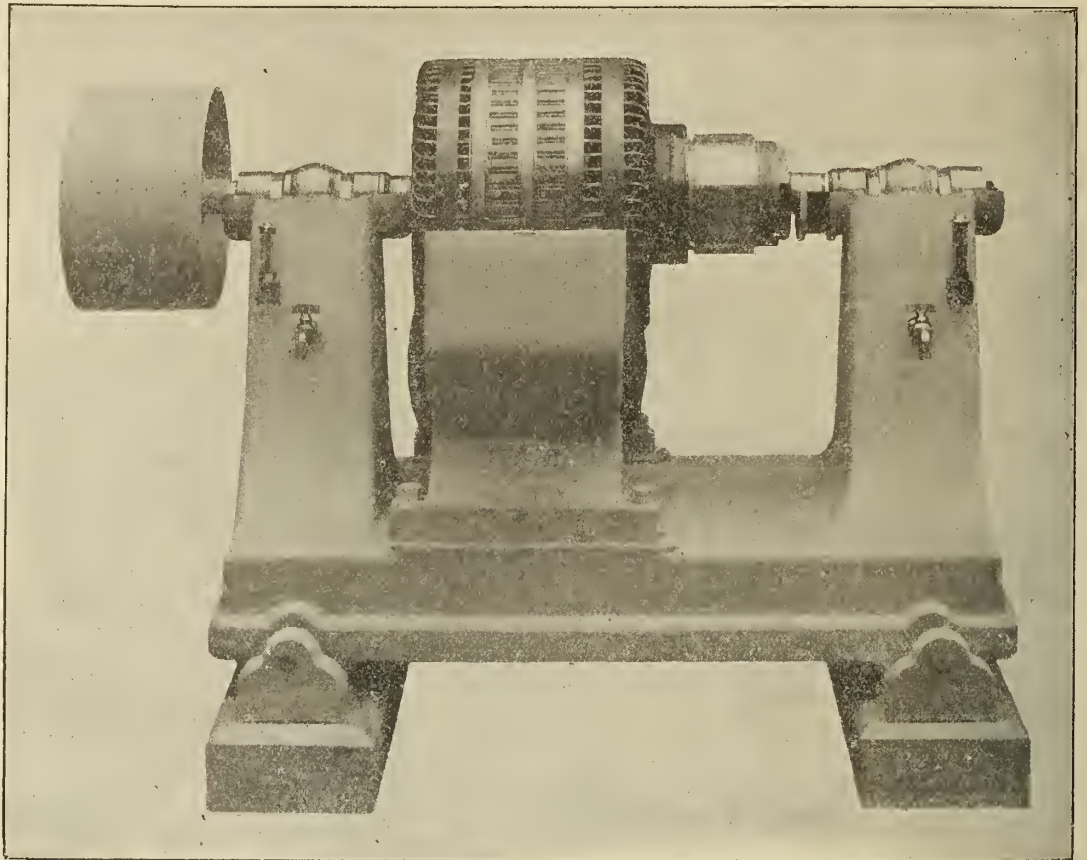
The field magnets are made from a special quality of cast steel, and the metal is so placed, and so used, that there is no

choking of lines at any point of the magnetic circuit; nor has any attempt been made to work the magnetic frame to its full limit of saturation.

The shunt and series coils are wound up separately,

and are secured to the pole pieces by suitable clamps.

The slotted type of armature is used on this machine. The coils are so designed and placed in the armature



OPEN VIEW—DIRECT-CURRENT MULTIPOLAR DYNAMO.

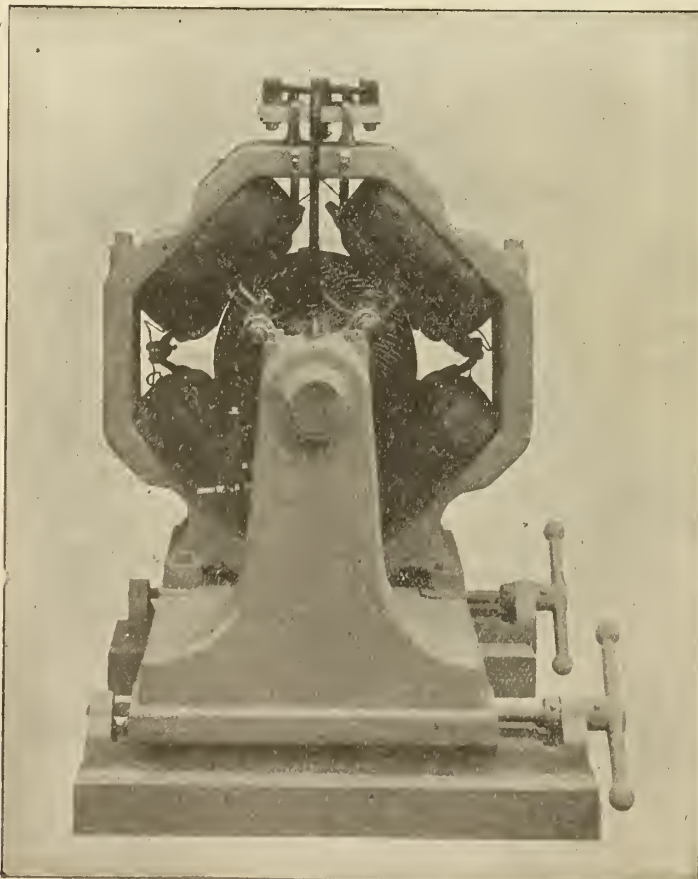
that they are interchangeable at every point. They are of equal length and ample conducting capacity.

The commutator is very large and designed for the use of carbon brushes. The carbon brushes are so constructed that the contact between the carbon and the machine terminals is through a flexible conductor strip clamped securely to the carbon brush. This design absolutely prevents arcing between the brush and its holder.

The bed-plate is made in one piece, and is very stiff and strong; it supports the barrel bearings of the armature, which are of the self-aligning and self-oiling type.

The apparatus is made in the following sizes, viz., 4, 7½, 15, 20, 30, 40 and 60 k.w.

The Electrical Construction Company also manufacture a complete line of direct-current stationary motors, in sizes from one to one hundred horse power, and have a fully equipped repair shop. Their office is at 90 York street, London, Ont.



NEW TYPE DIRECT-CURRENT MULTIPOLAR DYNAMO.

The city council of Grand Forks, B. C., will borrow money with which to purchase an electric light plant.

The town of Owen Sound, Ont., have accepted an offer made by the Owen Sound Electric Light Company to supply 30 lights at \$75.00 per year, running under the moonlight schedule.

The motor of the new swing bridge at Hamilton Beach burned out recently, and the bridge had to be swung by hand. James Eustace, the young man who was operating the bridge when the motor burned out, had a narrow escape, his watch chain being fused and his face singed. The accident was caused in a peculiar manner. When Eustace was in the power house his watch chain fell across a wire, making a short armature and sending up a blaze several feet into the air.

WESTERN ONTARIO LIGHTING PLANTS.

BELOW will be found brief descriptions of several electric lighting plants in Western Ontario, from the perusal of which some points of instruction may be gathered.

DRESDEN ELECTRIC LIGHT PLANT.

The old plant in this town was totally destroyed by fire in August, 1896, and the present plant was installed in September following. It is located in a detached brick one-story building, 20 x 40 feet, and is an alternating system, a Thomson-Houston generator, with speed of 1,500 revolutions, furnishing current for nine arc lights and about 300 incandescent lamps. The switch-board is fitted with Canadian General instruments of latest design. One of the special features of this plant is said to be the very satisfactory service to patrons.

The belt is run direct from engine to dynamo, no counter-shafting being used. The steam power is supplied by a 95 h. p. boiler and an 85 h. p. Leonard Ball automatic cut-off engine. The plant is under the efficient management of Mr. W. F. Jameson, and is owned by Mr. J. E. Gordon, the proprietor of the Dresden stave mills.

ST. MARY'S ELECTRIC LIGHT PLANT.

This plant, owned and operated by Mr. L. H. Reesor, is furnishing a very satisfactory service to the citizens of St. Marys. The company have installed now about 1,000 incandescent lights of 16 candle power. Their power house is conveniently situated in a central locality and is equipped with a National 500 light machine and two 50 Ball arc generators, with National switch-board and instruments.

In connection with the plant there is a well equipped stock room, provided with shelving and compartments, and well stocked with all the necessary parts required for repairs. Power is supplied by two 50 h. p. turbines, supplemented by a steam engine to maintain an equal running power. Mr. W. J. Stevenson is the electrician in charge.

FOREST ELECTRIC LIGHT COMPANY.

The electric light plant at Forest is owned and operated by Messrs. Hamilton & Proutt, the well known planing mill proprietors. It is located in a commodious brick addition to their mill, and is equipped with 800 light Royal dynamo for their incandescent light system, and a 50 arc light Thompson generator for arc street lamps. A special feature of this plant is a handsome marble switch board, 6 x 4 ft., fitted with General Electric instruments. The mill engine supplies the necessary power. This company are at present furnishing about 250 incandescent lamps and 11 arc lights.

PETROLIA ELECTRIC LIGHT, HEAT AND POWER COMPANY.

The officers of the above company are as follows: G. Y. Ashworth, president; Walter MacDonald, vice-president and secretary; W. H. Ashworth, manager. The plant was installed and commenced service on January 15th, 1895. The power house is a frame structure 35 x 70 ft., with flat roof. The driving plant consists of two boilers, one of 100 h. p. and the other of 150 h. p. capacity, and a 100 h. p. Wheelock condensing engine, with thirteen foot fly-wheel. The generators are a Thomson-Houston 1,000 light alternator, a 50 light arc, and a 350 light Royal, for use when overloaded, the switchboard instruments being from the Canadian General Electric Co. Their service at first consisted of 30 arc lights and about 200 incandescent lamps, but at present they are furnishing 39 arc lights, with a candle power of 1,200, and 1,700 incandescent lamps.

Electric power from this plant is used in oil pumping, this being the first instance in the world where electricity has been used for that purpose. During last July the company put in a 15 k.w. General Electric generator

of 500 volts, to furnish power for a motor at a batch of sixteen wells, and which has given every satisfaction. The increasing number of wells being bored will lead to its more general adoption, as its adaptability and cheapness over steam power has now been proven.

Owing to scarcity of water this plant has a very novel condensing system, making use of four tanks, fifty feet in depth by twelve feet in diameter, connected by syphon arrangement, the pump for heater being fed from nearest tank by three inch pipe, and the water from condenser being carried by pipe and open trough to farthest tank.

This company are oil producers as well, having four wells in their yard which they operate.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

NOTE.—Secretaries of Associations are requested to forward matter for publication in this Department not later than the 25th of each month.

TORONTO NO. 1.

The regular meeting of Toronto No. 1 was held on July 7th in Engineer's Hall, 61 Victoria street. After the regular business had been dealt with, Bro. E. J. Philip installed the following officers for the ensuing year: President, G. C. Mooring; vice-president, T. Eversfield; recording secretary, J. W. Marr; financial secretary, J. Bain; conductor, G. Thompson; door-keeper, T. Cadwell; treasurer, S. Thompson.

MONTREAL NO. 1.

A largely attended meeting of Montreal No. 1 was held in their hall on Craig street on June 17th, the occasion being the twelfth annual meeting for the election of officers. The following were elected: President, Wm. Smyth; 1st vice-president, Wm. Bowden; 2nd vice-president, P. McNaughton; recording secretary, J. O'Rourke; financial secretary, Harry Nuttall; corresponding secretary, Thos. Ryan; treasurer, G. Jones; librarian, Wm. Ware; conductor, J. Morrison; door-keeper, James Wilson; trustees, J. J. York, O. G. Granberg, George Hunt. A large amount of business was transacted. Several new by-laws were passed and others altered, tending towards the better government of the association.

HAMILTON NO. 2.

At the regular meeting of Hamilton No. 2, held a fortnight ago, the following officers were installed by the past-president of the executive, Bro. Blackgrove, of Toronto No. 1: President, W. Norris; vice-president, G. Mackie; recording secretary, J. Ironside; financial secretary, J. Carroll; treasurer, W. Nash; conductor, J. Johnston; door-keeper, T. Carter. The retiring financial secretary, E. Nash, was presented with a handsome secretary by past-president R. Mackie, on behalf of the association.

LONDON NO. 5.

The election of officers took place at the last meeting of the above association, with the following result: D. G. Campbell, president; B. Bright, vice-president; W. Meaden, treasurer; W. Blythe, secretary; W. Burkholder, conductor; R. Evans, doorkeeper. The officers were installed by the retiring president, Bro. G. Risler. The subject for discussion was "The Gain in Power Due to the Expansion of Steam in a Cylinder," which was ably handled and illustrated. A number of engineering questions are being prepared for competition by the members, for the best solution of which a prize will be given.

KINGSTON NO. 10.

Kingston branch installed new officers at their last meeting, past-president S. Donnelly being master of ceremonies. The officers now are: F. Simmons, president, re-elected; C. Asselstine, vice-president; J. L. Orr, secretary; C. Selby, treasurer; W. Woodrow, conductor; R. Burgess, doorkeeper; S. Donnelly and C. Blomley, trustees. F. Simmons and C. Selby were appointed delegates to the annual convention to be held in Brockville next month.

EDUCATIONAL DEPARTMENT

INTRODUCTORY

After mature deliberation the publisher of this journal has decided to devote a certain amount of space each month to what may be termed an Educational Department, wherein both mechanical and electrical formula and mathematical problems will be discussed, illustrated, and as far as possible rule and example given. At the request of the editor, I have with pleasure undertaken to contribute to this department regularly each month, and before discussing actual mathematical problems, wish to briefly introduce the subject at issue.

The primary object of this department is chiefly to increase the value of an already valuable paper, by placing in the hands of every engineer who has any knowledge of the rudimentary principles of mathematics, such matter as will enable him by a little study to master the most intricate mechanical and electrical formula. Many of our most valuable engineering works and publications from time to time contain formula that is in many cases but vaguely understood, and very often entirely misunderstood, thus rendering an otherwise valuable work practically valueless to the reader.

Just at what particular point our calculations should commence became a matter of serious thought, and past experience had to be carefully considered, bearing in mind the fact that there are many really good engineers whose early education has, through force of circumstances, been deficient, and many others who, through lack of opportunity, have not been able to review their early education for years. Knowing by observation and experience the great necessity of having a thorough elementary education before attempting to digest and calculate problems, and the almost utter impossibility of the student arriving at a satisfactory conclusion of his studies without a thorough knowledge of the principle of mathematics involved, I have decided to commence at a point and carry out the programme outlined in this journal—commencing at the foundation and advancing by easy stages until the principles underlying the most obtuse and difficult formula can be readily explained and easily understood. The advantages to be derived from an education of this kind, coupled with practical mechanical ability, is too well understood to require comment.

The programme which has been outlined for the succeeding nine months will embrace:

DECIMAL FRACTIONS—Definitions and explanation of principles of, and method of reduction to common fractions, and vice versa.

SQUARE AND CIRCULAR MEASURE—Definition and explanation and practical demonstrations of.

CUBICAL AND CYLINDRICAL MEASUREMENTS—Definitions and explanations of, with practical hints.

SQUARE AND CUBE ROOT—Definitions and explanations of.

SAFETY VALVE CALCULATIONS—(Spring and Lever Types)—Principles of, with practical demonstrations.

BOILER CONSTRUCTION—Stays, rivets, joints and seams, iron and steel plate—strength of, with formula and practical demonstrations.

It is not the intention to fill these columns with a mass of figures hastily compiled without reference to any particular object; on the contrary, every problem will be carefully thought out, and only such information given as will be of use to you, and an effort will be made, based on experience and a knowledge of the requirements, to make this series of tests complete in every particular.

WM. THOMPSON.

[ARTICLE III.]

PRACTICAL MEASUREMENTS.

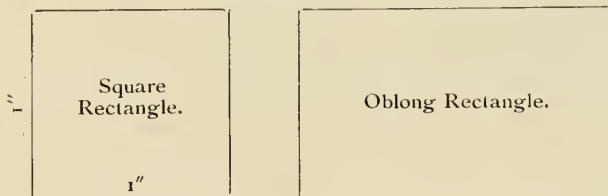
THE practical measurements herein referred to and treated as being of especial benefit to engineers, are distinguished as measurements, of surface, of volume and of capacity.

MEASURES OF SURFACE OR SQUARE MEASURE.

SURFACE is that which bears reference to length and breadth only, depth or thickness not being considered.

THE AREA of a surface is the number of square feet, inches or yards, etc., that such a surface contains.

A RECTANGLE is a surface which has four right angles.



Rule : To find the area of a rectangle or square, multiply the given breadth by the given length, and the product will be the area.

Rule : To find the required length of either side of a rectangle or square, divide the given area by the given length of known side.

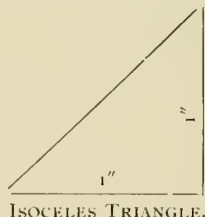
Example : Find the length of a surface whose area is 95 sq. in. and breadth 5 in.

$$95 \div 5 = 19 \text{ in.} = \text{length required.}$$

IRREGULAR OR TRIANGULAR MEASUREMENTS.

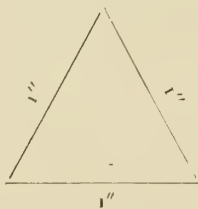
A triangle is a surface having three sides and three angles.

An Isosceles triangle is a triangle having two equal sides.



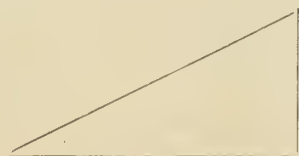
ISOCELES TRIANGLE.

An Equilateral triangle is a triangle having three equal sides.



EQUILATERAL TRIANGLE.

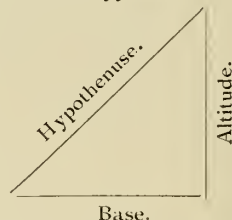
A Scalene triangle is a triangle which has no two sides equal to each other.



SCALENE TRIANGLE.

The base of a triangle is the line which intersects the other two lines at the point greatest distant from the vertex.

The lines representing the base and altitude are perpendicular to each other, and if a triangle be placed vertically, the base will be the side on which it appears to stand.



Rule : To find the area of a triangle, multiply the base by one-half the altitude, and the product will be the area.

Rule to find either the altitude or base of a triangle, area, and one side being known : Divide the area by one-half the given dimension, and quotient will be required dimension of other side.

Example : Find the required length of the base of a Scalene triangle whose altitude is 6 inches and area equals 36 inches.

$$36 \div \text{by one-half altitude} = 36 \div 3 = 12", \text{ required length of base.}$$

CIRCULAR MEASUREMENT.

A circle, as geometrically defined, is a plain figure bounded by a curved line, all parts of which are equally distant from the centre.

The circumference of a circle is the curve which bounds it.

The diameter of a circle is a straight line that passes through its centre.

The radius of a circle is a straight line that joins the centre to a point in the circumference.

[Note : Referring to this, it follows that the radius is one-half of the diameter.]

Rule : To find the circumference of a circle, the diameter being given, multiply the given diameter by 3.1416, and the product will be the circumference.

Rule : To find the diameter of a circle, the circumference being given, multiply the given circumference by the decimal .3183, and the product will be the diameter.

Rules : To find the area of a circle, the circumference, radius or diameter being known,

Multiply the circumference by one-fourth the diameter, and the product will be the area ;

Or, multiply the square of the radius by 3.1416, and the product will be the area ;

Or, multiply the square of the diameter by .7854, and the product will be the area.

Example : Find the area of a circular bolt 3.1416 inches in circumference.

$$\text{Circumference} \times .3183 \text{ equals dia.}$$

$$3.1416 \times .3183 = 1" \text{ diameter,}$$

$$1 \div 4 = .25 = \text{one-fourth dia.}$$

$$3.1416 \times .25 = .7854 \text{ sq. in. area.}$$

Example : Find the area of a circle whose radius is one-half inch.

$$\text{Radius squared} \times \text{by } 3.1416 =$$

$$.5 \times .5 = .25 \times 3.1416 = .7854 \text{ sq. in. area.}$$

Example : Find the area of a circle whose diameter is 1 inch.

$$\text{Diameter squared} \times .7854 =$$

$$1 \times 1 = 1 \times .7854 = .7854 \text{ sq. in. area.}$$

A review of these examples will prove clearly to the student why constant .7854 is used in formula when it is necessary to find area of any circle, and needs no further comment.

MEASURES OF VOLUME OF SOLID BODIES OR CUBICAL MEASUREMENTS.

Cubical measurement includes length, breadth and thickness being taken into consideration.

The process of finding the cubical contents of a solid body is similar to finding the area; in fact, area multiplied by thickness will give cubical contents.

MEASURES OF CAPACITY AND CUBICAL CONTENTS OF SQUARE AND CYLINDRICAL BODIES.

Measures of capacity embrace measurements of barrels, tanks, bins, boxes, cylinders, etc., etc.

The liquid gallon of the United States contains 231 cubic inches.

The Imperial or British gallon contains 277.274 cubic inches.

A cubic foot of water contains approximately 6.25 Imperial gallons and weighs 62.5 pounds avoirdupois at 62° F. under atmospheric pressure.

Rule: To find capacity of a square tank, dimensions of which are known, multiply length by breadth and product by depth, and result will be cubical contents.

Example: Find the number of Imperial gallons of water a rectangular tank will contain, inside measurement of tank being: length 20 feet, width 15 feet, depth 3 feet 6 inches.

Formula: $\frac{\text{Length} \times \text{width} \times \text{depth} \times 1728}{277.27} = \text{Imperial gallons.}$

$$\begin{array}{r} 277.27 \\ 20' = \text{length.} \\ 15' = \text{width.} \\ \hline 100 \\ 20 \\ \hline 300 \\ 3.5 = \text{depth.} \\ \hline 1500 \\ 900 \\ \hline 1050.0 = \text{cubical contents in cu. feet.} \\ 1728 = \text{cubic inches in one cu. foot.} \\ \hline 8400 \\ 2100 \\ \hline 7350 \\ 1050 \\ \hline 1.814,400 = \text{cubic inches} = \end{array}$$

$$1.814,400 \div 277.27 = 6543.8 \text{ Imp. gallons,}$$

or, when absolute correctness is not required, short method formula as follows may be adopted.

Length in feet $\times$ width in feet $\times$ depth in feet $\times$ 6.25 = Imp. gallons.

$$20' \times 15' \times 3' 6'' = 1050 \times 6.25 = 6562.5 \text{ Imp. gals.}$$

Example (2): How many gallons (U. S.) of oil will cylindrical oil tank hold whose internal dimensions are: Depth 4 feet 6 inches, diameter 3 feet.

Formula:

$$\frac{\text{Diameter squared} \times .7854 \times \text{depth} \times 1728}{231} = \text{U. S. gallons.}$$

$$\begin{array}{r} 3' \times 3' = 9' \times .7854 = 7.0686 = \text{area in sq. feet} - 7.0686 \\ \hline 4.5 \text{ depth.} \\ 31.80 \text{ cap. in cu. ft.} \\ \hline 1728 \\ \hline 54950.4 \text{ cap. in. cu. in.} \\ 54950.4 \div 231 = 237.9 \text{ gallons oil.} \end{array}$$

Example (3): It is required to fit a tank into a recess 6 ft. wide and 14 ft. 6 in. long. Tank to be made of 3 in. plank and contain 5000 Imperial gallons of water. What height should tank be so as to allow sides to project 6 in. above the water line?

First find exact internal measurement of tank, then exact quantity of water contained in each inch of depth; divide required quantity of water by this product, and add 6. Result will be required height.

Dimensions of recess are given as 6' $\times$ 14' 6". Since, however, tank is to be constructed of 3 in. plank, twice this thickness must be deducted to get internal measurement of tank,

$$\begin{array}{l} \therefore 6' - 6'' = 5' 6'' \text{ internal width of tank.} \\ 14' 6'' - 6'' = 14' \text{ internal length of tank.} \\ 14' \times 5' 6'' = 11.088 \text{ sq. inches.} \\ 11.088 \div 277.27 = 39.99 \text{ Imp. gals. per inch.} \\ 5000 \div 39.99 = 125 \text{ inches to water line.} \\ (125 + 6) \div 12 = 10' 11'' \text{ height of tank.} \end{array}$$

Example (4): A tank 1 ft. 9 in. deep, 2 ft. long and 4 ft. wide, is found to contain 70 Imperial gallons of oil. How far from the top is the oil, and what is capacity of tank when full?

Since one gallon of oil is equal to .16 cu. ft., we can here materially shorten our calculation by working decimally.

First find how many cubic feet 70 gallons are equal to by multiplying by .16.

$$70 \times .16 = 11.2 \text{ cu. feet,}$$

and as the tank is 2 feet by 4 feet, its base will equal 8 sq. ft.

Then divide 11.2 cu. feet by 8 sq. feet to get height of oil.

$$11.2 \div 8 = 1.4 \text{ feet height of oil.}$$

The tank is given as being 1.75 feet high,

and the oil is 1.40 " "

then oil is 0.35 feet from the top.

$$0.35 \text{ feet} \times 12 = 4.2 \text{ inches distance from top of tank to oil.}$$

To find capacity of tank when full, we first find cubical contents of tank in feet and then divide by .16.

$$1.75 \times 2 \times 4 = 14 \text{ ft., cubical contents of tank.}$$

$$14 \text{ feet} \div .16 = 87.5 \text{ gallons of oil in tank when full.}$$

Example (5): If one cubic foot of coal weighs 84 pounds, what weight of coal will a car contain 30 feet long, 6 feet wide and 5 feet deep?

First find cubical contents of car in feet, then multiply by weight per cu. ft. Result will be total weight of coal.

$$\therefore 30 \text{ ft.} \times 6 \text{ ft.} \times 5 \text{ ft.} = 900 \text{ cu. feet.}$$

$$900 \times 84 = 75600 \text{ pounds of coal.}$$

Example (6): How many cubic feet of steam will a cylinder contain, 18 in. $\times$ 36 in., with 5 per cent. clearance, and how many cubic feet will be used per hour if engine runs 75 revolutions per minute.

First find cubical contents of cylinder, including clearance, then multiply by strokes per minute, and this product by 60. Result will be number of cubic feet of steam consumed per hour.

$$18 \text{ in.} \times 18 \text{ in.} \times .7854 = 254.47 \text{ sq. in., area of cylinder.}$$

254.47 $\times$ 36 in. = 9160.92 = cubical contents of cylinder without clearance.

9160.92 $\div$ 95 $\times$ 100 = 9653.6 cu. in. = contents of cylinder, clearance included.

$$9653.6 \div 1728 = 5.58 \text{ cu. feet.}$$

$$5.58 \times 75 \times 2 = 837 \text{ cu. ft. steam per minute.}$$

$$837 \times 60 = 50,220 \text{ cu. ft. of steam used per hour.}$$

PRACTICAL RULES WORTH REMEMBERING.

The diameter of a circle $\times$ by 3.1416 = the circumference.

The circumference of a circle $\div$ by 3.1416 = diameter.

The radius of a circle $\times$ by 6.283185 = circumference.

The circumference of a circle $\div$ 6.283185 = radius.

The square of the radius of a circle $\times$ 3.1416 = the area.

The square of the diameter of a circle $\times$ 0.7854 = the area.

The square of the circumference of a circle $\times$ 0.07958 = the area.

The circumference of a circle $\times$ 0.159155 = the radius.

The square root of the area of a circle $\times$ 1.12838 = the diameter.

A semi-circle is $\frac{1}{2}$ of a circle, or 180 degrees.

A quadrant is $\frac{1}{4}$ of a circle, or 90 degrees.

A sextant is $\frac{1}{6}$ of a circle, or 60 degrees.

Next issue will contain examples of square and cube root, and definitions of signs and symbols for algebraical formulae.

SPARKS.

The running of electric cars on Sunday in Kingston is being protested by the Lord's Day Alliance.

The Nelson Electric Light Company has decided to increase the capacity of its plant, at a cost of \$10,000.

A by-law will be submitted to the ratepayers of Vernon, B. C., to raise \$12,000 for the purchase of an electric light plant.

A perfected horseless carriage, it is announced, will soon be turned out of the works of the General Electric Company, in Lynn, Mass.

The Osler syndicate is still negotiating to secure control of the Hamilton and Dundas and the Hamilton street railways. Several offers have been made, but as yet no agreement has been reached.

A proposition has been made to amalgamate the Brantford Street Railway and the Hamilton, Chedoke and Ancaster Electric Railway for the purpose of making direct connection with Paris, by way of Brantford.

The vast march of progress within one generation is strikingly illustrated by the death, only a short time ago, of Joseph Bell, the engineer who drove Stephenson's first locomotive. After escaping numerous perils on the road, he met his death by falling through an open hatch on the street. Another illustration is Sir Isaac Holden, who was a member of last parliament, and is still an active old gentleman, who invented the lucifer match.

SPARKS.

The Association of Telephone Superintendents met at Niagara Falls, N. Y., on June 16th.

The town of Dartmouth, N. S., have now under consideration offers for electric lighting.

The Toronto Electrical Works Company has been incorporated at Toronto, with a capital stock of \$30,000.

A money by-law, to increase the electric light plant, was recently defeated by the ratepayers of Picton, Ont.

Mr. W. R. Burke, manager of the G. N. W. Telegraph office at Ingersoll, Ont., was recently smothered by gas.

It is expected that telephone communication between Halifax and St. John will be established within a short time.

Walter Stewart's saw mill at Lucknow, Ont., in which was located the electric light plant, was recently destroyed by fire.

Superintendent H. W. Kent, manager of the Nelson & Vernon Telephone Co., has completed a line from Rossland to Spokane.

The Bell Telephone Company will supply the town of Carleton Place, Ont., with an electric fire alarm system, at a cost of \$1,000.

A by-law to grant \$5,000 towards an electric railway from Perth to Lanark was defeated by the ratepayers of the former town recently.

The estate of the defunct Citizens' Telephone Exchange at Waterloo, Que., has been sold to the Pare & Pare Company, of Granby.

E. J. Cuisack, of Havelock, N.B., has invented a compressed air motor for which he has secured patents in Great Britain, Canada and the United States.

The American Street Railway Association, which held its annual meeting in Montreal two years ago, will assemble in convention at Niagara Falls, N.Y., on October 19th next.

It is with regret we learn that the well-known firm of Patterson & Corbin, car manufacturers, St. Catharines, Ont., have not been prosperous of late, and that it is probable their works will be closed down.

The Taylor Hydraulic Air Compressor Company, of Montreal, elected the following directors for the ensuing year: Messrs. S. Carsley, Joseph R. Fair, George Durnford, W. L. Campbell and R. L. Murchison.

The receipts of the Toronto Street Railway Company for the month of June show a gain over the same month last year of about \$7,000, the respective figures being, \$92,015.16 and \$85,195.13. In the former figure is included the receipts on Sundays.

The By-Town and Aylmer Turnpike Union Road Company have entered an action against the Hull Electric Railway Company, claiming \$20,000 damages, and to compel the latter company to remove their line from Aylmer road to Suspension Bridge.

The C. P. R. Telegraph Company recently made a record in connection with the Queen's message to Ottawa. The message from Buckingham Palace to the Earl of Aberdeen, Rideau Hall, was sent direct by the Commercial Cable Company to Canso and from there over the C. P. R. line to Ottawa. The period of transmission, including return message, was seven minutes.

The Canadian Power Company have commenced work on its proposed power canal at Niagara Falls, Ont. This canal will be about 200 feet wide at the bottom and about 4,000 feet long, and will extend from the Chippewa Creek to the head of the Dufferin Islands. Mr. R. Paine, of Niagara Falls, who is one of the promoters, states that it is the intention to develop 40,000 h.p. at once.

A syndicate, composed of Messrs. T. G. Blackstock, J. W. Langmuir, W. Willson, W. B. Rankine, W. C. Ely, Alexander Fraser and J. M. Bostwick, have laid before the Ontario Premier a project to construct another bridge across the Niagara river, near Lewiston, and an electric belt line railway passing over the two bridges and the intervening stretches along both sides of the river.

The annual meeting of the shareholders of the Dominion Telegraph Company was held in Toronto recently, at which the board of directors were re-elected, viz., Thomas Swinyard, president; Hon. Sir Frank Smith, vice-president; Gen. Thomas T. Eckert, A. G. Ramsay, Henry Pellatt, Hector Mackenzie, Thos. F. Clarke, Thomas R. Wood, Charles A. Tinker, and F. Roper, secretary and treasurer.

Alderman Woods has given notice in the Toronto city council that he will move that it be an instruction to the city engi-

neer, when considering the cost of establishing an electric light plant at the new municipal buildings, to also consider the advisability of installing a plant of sufficient capacity to provide for the lighting of all municipal buildings, public streets and parks, as well as the supply of power to manufacturers.

After careful investigation into the circumstances of the recent Point Ellice bridge disaster at Victoria, B.C., the jury has rendered a verdict holding the directors of the Consolidated Railway Company responsible for the lives lost. The city council was arraigned as guilty of contributory negligence and the officials of the corporation were absolved of personal responsibility. It was found that the accident would not have occurred but for the improper crowding of the cars, and also that the bridge was not constructed according to the original specifications.

The Minister of Public Works for the Dominion has made known the intention of the Government to install a complete electric light plant at the Parliament Buildings at Ottawa, at a cost of \$75,000. At present the buildings are lighted by both gas and electricity, the former costing from \$18,000 to \$22,000 per year. It is proposed to enlarge the present station under the hill sufficient to develop power to light the buildings by electricity throughout and drive a system of electric pumps to afford adequate protection against fire. Tenders for the plant will be invited.

An exchange tells of a curious effect of an electrical storm in Chicago on June 16th. The iron structure of the swing bridge over the river at Harrison street was charged. This bridge is electrically connected with the return circuit of an electric railway line, and this connection seemed to "short-circuit" the electricity of the air. George Browne, who was driving near by at the time, urged his horse out upon the bridge in spite of the blue flames that were playing along the iron rods. The animal was hardly upon the structure before the electricity leaped up through the iron calks of its shoes and it went down in a heap, stone dead. Brown leaped from his seat and ran away, and the few pedestrians on the bridge at that time made all haste to get away. A fire and police call brought policemen and a chemical engine to the spot. The police had hard work to keep the crowd back. The draw was finally swung open and the circuit broken. During the storm one young man was struck by lightning and instantly killed. Several others were injured, and there was considerable damage to property.

NOTES.

Vertical belts should be drawn tight enough so that the belt will cling to the lower pulley. Laced belts often break where connected, on account of friction caused by slipping and movement between the lace and belt, which wears away the lace.

One pound of carbon, in burning perfectly, forms $2\frac{1}{3}$ pounds of carbonic oxide, and develops 4344 heat units. The carbonic oxide, in burning perfectly, develops 10,210 heat units in forming carbonic acid, making $10210 + 4344 = 14554$ heat units, or the same amount of heat units that would be obtained by the complete combustion of one pound of carbon.

TO PREVENT BREAKAGE OF GLASS GAUGES.—Breakage of glass water-gauges fitted to steam boilers may be prevented in many instances by fusing the edges at the ends, and so finishing them off smoothly and evenly instead of breaking and grinding them. Guards made of toughened glass are also recommended as means of protection to persons standing by in case of gauge-bursting.

Herren L. Holborn and W. Wien have compiled a table, reproduced in the Scientific American, showing the heat-conducting power of the different values. The average value of the different kinds of iron and steel is given. The factor, R, indicates that through a plate of one centimetre thickness, at a difference of temperature of one degree for one square centimetre each, a quantity of heat passes which will increase the temperature of R gramme of water by one degree: Copper, R equals 0.918; iron, R equals 0.156; steel, R equals 0.062 to 0.111; zinc, R equals 0.292; tin, R equals 0.150; lead, R equals 0.079.

We have received, by the kindness of Messrs. John Starr, Son Co., a copy of an illustrated souvenir of the Queen's Diamond Jubilee, entitled "Halifax of To-Day," and published by W. H. Howard. It contains numerous half-tone illustrations of buildings and scenes in Halifax, together with a brief description of same.

ELECTRIC RAILWAY DEPARTMENT.

NEW METHOD OF STRINGING TROLLEY WIRE.

A novel method of stringing trolley wire was recently used by the Sioux City Traction Company on a line lately completed from Covington to South Sioux City. The wire was live when strung, and as it was fastened in place in the hangers it was used to furnish current to the car to carry it to the next span wire.

The spool on the car on which the wire to be strung was wound, was placed in a wooden rack on wooden supports and arranged with a break, which was operated by a man standing just back of the spool. By means of this break it was possible to keep the proper tension on the wire. The car was anchored every 1,000 feet and the work performed as easily as reeling a dead wire on the ground. A half a mile of wire was recently strung in half a day, and the company states that it expects to put up all its own lines hereafter in this way.

TORONTO STREET RAILWAY ASSESSMENT CASE.

JUDGMENT has again been given in favor of the Toronto Street Railway in its appeal against the assessment on rails, wires and poles in Ward 1, Judges McGibbon, Dartnell and McDougall each concurring in the decision.

Judge McGibbon's opinion was set forth as follows:—I still retain the opinion which I expressed in my judgment in the case of the Toronto Railway Company v. the City of Toronto, in 1896, which was a case similar to the one we are now asked to adjudicate upon. Since my said judgment was delivered the judgment of the Supreme Court in the case of the Consumers' Gas Company of Toronto v. Toronto has been delivered, and was referred to on the argument in this case, and it was contended that the judgment in that case concluded us in our judgment in this case. After reading the judgments of the Chief Justice and of Justice Gwynne in the Consumers' Gas Company of Toronto v. the City of Toronto, I am of opinion that this appeal is not determined by that judgment. I find the principle of the judgment of Gwynne, J., is founded on the compulsory power of the Gas Company to acquire and hold land. He says:—

"The sole question is as to the validity of the assessment of the mains and pipes as land and real property. Section 1 of the Act of Incorporation (II. Vict., Chap. 14), conferred upon the company power to purchase, take, and hold lands, tenements and other real property for the purposes of the company, and for the erection and construction and convenient use of the gas works of the company. By section 13 the company are empowered to break, dig up, and trench the street, etc., for the laying down of mains and pipes, etc. This section 13 operates as a legislative grant to the company of the land of the said streets, and below the surface of the said streets as the company finds it necessary to take and hold under section 1, and when the mains and pipes are placed there the land occupied by such mains is land taken and had by the company for the necessary purposes of the company, etc., and is liable to assessment as land."

The Toronto Railway Company have only a street railway privilege, for the purposes of their railway, and have neither the same powers nor property in the street as the Consumers' Gas Company have in the lands occupied or used by them for their gas works and pipes. And I do not think that the judgment in the Supreme Court in the Consumers' Gas Company case governs

this appeal. I think the appeal should be allowed, and the assessment struck from the roll.

Judge Dartnell's opinion was summed up in these terms:—This appeal comes up in a slightly different shape from that heretofore disposed of by the Board of the County Judges assigned to take such cases under the assessment acts and amendments thereto. The respondents rely upon the decision of the Supreme Court in the Consumers' Gas Company v. the City of Toronto as affecting the former judgments given herein. So far as the matter of the former appeal is concerned I based my judgment largely upon the construction of the agreement between the company and the city. I express no opinion upon the effect of the recent judgment beyond saying that I cannot see how it affects the ratio decidendi of my former opinion, which I hereby reiterate and affirm.

It is again argued that the exemption from taxation which I conceive has been conferred upon the company by their agreement with the city is illegal and void. The short answer to this is that this agreement has been confirmed by an act of the legislature, and has thus been taken out of the ordinary rules which govern such assessments. The city, should I be wrong, has the option of either proceeding with the pending appeal to the Supreme Court, or by taking an appeal to the Court of Appeal, which they are now enabled to do. I think the assessment should be struck out and the appeal allowed.

Judge McDougall delivered a verbal judgment concurring in the opinions of Judges McGibbon and Dartnell.

SPARKS.

The Ottawa Electric Railway Company will borrow \$500,000 to cover the cost of recent improvements.

A report from San Francisco, Cal., states that W. B. Broadbury, a millionaire, has been sentenced to 24 hours' imprisonment on his conviction for the second time for spitting in street cars.

The Sherbrooke Street Railway Company, Sherbrooke, Que., having succeeded in securing water power privileges, have begun the work of construction of power house and surveys for road bed.

Barrister Rowan, of Toronto, was recently granted \$1,500 damages for being injured by a trolley car on Spadina avenue. The Toronto Railway Company appealed the case and Judge McMahon has given his decision in favor of the company. The plaintiff will probably appeal.

The British Columbia Electric Railway Company has been registered in British Columbia to take over the business of the Consolidated Railway Company and to construct and operate electric railways, etc., throughout British Columbia. The head office is in England. The capital of the new company is £250,000.

The month of June proved to be the heaviest in the history of the Montreal Street Railway. The earnings amounted to \$130,676.77, an increase of \$14,248.11 over June, 1896. The average daily earnings during the month were \$3,481.11, which is an average daily increase of \$215.74. The total increase in earnings for the first nine months of the fiscal year amount to \$58,893.82, the figures being \$952,120.81.

Professor George Forbes, F. R. S., who played an important part in the "harnessing of Niagara," is expected to arrive in England in a few days from Egypt, where he has been making an extensive tour in many parts of the globe with a view to reporting on the utilization of water power for the generation of electrical energy. He visited New Zealand and Africa, and while in Northern Rhodesia, in order to report on a scheme for using the water power of the Victoria Falls on the Zambesi river, to generate electricity and supply it to the various centres of population throughout Rhodesia. In Egypt, Professor Forbes had a look at the Nile cataracts, and has expressed a highly favorable opinion about utilizing their waste power for generating current.

SPARKS.

Wm. Davidson has started boiler works at Halifax, N. S.

The electric light plant at Huntingdon, Que., was recently put in successful operation.

The council of Kamloops, B. C., has offered \$4,000 for the electric light plant in that town.

The Citizens Telephone & Electric Co. are erecting a new office block at Rat Portage, Ont.

The village of Magog, Que., has recently provided the sum of \$10,000 for the purchase of an electric light plant.

Mr. Sanford, the absconding treasurer of Barrie, Ont., was also manager of the Barrie Electric Light Company.

The West Kootenay Power & Light Company are about to commence the erection of their power house at Middle Falls, on the Kootenay river.

Mr. Harry Kendrick, of Walkerville, states that he finds the ELECTRICAL NEWS more interesting each issue, and that he could not afford to be without it.

The Kiel canal is lighted over its sixty-two miles by electricity, and is the longest distance in the world lighted continuously in that way. There are 5,000 poles.

Mr. Leo. B. Henderson has been appointed manager of the G. N. W. telegraph office in Ingersoll, Ont., which position was rendered vacant by the death of Mr. W. R. Burke.

The Nelson Electric Light Company, of Nelson, B. C., have placed an order for two additional 1,000-light dynamos. When installed these will give the company capacity to furnish 3,000 incandescent lights of 16-candle power.

The Fraserville Company, of Fraserville, Que., has been incorporated, to manufacture pulp, electrical machinery, etc. Among the promoters are Geo. White Fraser, Toronto; David Cook, Fraserville, and others; capital, \$50,000.

The Toronto Suburban Street Railway Company, according to its agreement, were to extend their track through the village of Weston. This has not been done, and a movement was recently commenced by the ratepayers of Weston to withdraw the franchise from the company.

The Brantford Machine and Tool Company has been organized at Brantford, Ont., and will occupy the old Waterous building. The promoters are Messrs. C. H. Waterous, F. Grabb, J. A. Bain, R. Kerr, T. A. Hollinrake, W. H. Shapley, and Lloyd Harris; capital stock, \$150,000.

The Stillwell, Pierce & Smith Valve Co., of Dayton, Ohio, who are putting in the hydraulic machinery at the Montmorency Electric Power Co.'s plant near Quebec, Que., are said to have been awarded the largest contract ever given for water wheel and hydraulic machinery. The plant is for the development of the water power at Missina, N. Y., for 75,000 horse power, and will cost one million dollars. The dynamo room is 700 x 65 feet and will contain fifteen dynamos of 5,000 horse power capacity each. The current is to be used in the manufacture of calcium carbide, to produce acetylene gas.

There is said to be a strong probability that a new electric road will be built at Niagara Falls South, Ont., a franchise having been applied for by the Lundy's Lane Electric Railway Company. The chief promoters are Messrs. Henry C. Symmes and R. Paine, of Niagara Falls. It is their purpose to construct a line which will connect with the Niagara Falls Park and River railway in the park and run through several of the village streets up to Lundy's Lane battle ground and observatory.

The Montreal Star gives the following reply to the question: "What year was the electric light discovered and introduced, and in what country?" Humphrey Davy produced electric light with carbon points in 1800. Professor Tyndall lectured at the Royal Institution, London, by the light of Jules Duboscq's electric lamp in 1855. The South Foreland lighthouse was illuminated by electricity in 1858, and the French government ordered eight lighthouses to be so illuminated in April, 1861. In 1878 T. E. Edison, of New York, discovered a method of producing more light at less expense, and from that time the movement towards electric lighting rapidly advanced.

MOONLIGHT SCHEDULE FOR JULY.

Day of Month.	Light.	Extinguish.	No. of Hours.
	H.M.	H.M.	H.M.
1.....	P. M. 8.20	A. M. 4.00	7.40
2.....	" 8.20	" 4.00	7.40
3.....	" 8.20	" 4.00	7.40
4.....	" 9.50	" 4.00	6.10
5.....	" 10.10	" 4.00	5.50
6.....	" 10.30	" 4.00	5.30
7.....	" 11.00	" 4.00	5.00
8.....	" 11.30	" 4.00	4.30
9.....	.....	" 4.00 }	3.50
10.....	A.M. 12.10	 }	
11.....	" 1.00	" 4.10	3.10
12.....	" 1.50	" 4.10	2.20
13.....	No light.	No light.	....
14.....	No light.	No light.	....
15.....	No light.	No light.	....
16.....	P. M. 8.00	P. M. 9.40	1.40
17.....	" 8.00	" 10.00	2.00
18.....	" 8.00	" 10.40	2.40
19.....	" 8.00	" 11.00	3.00
20.....	" 8.50	" 11.20	3.20
21.....	" 7.50	" 11.50	4.00
22.....	" 7.50	A. M. 12.20	4.30
23.....	" 7.50	" 12.40	4.50
24.....	" 7.50	" 1.10	5.20
25.....	" 7.50	" 2.00	6.10
26.....	" 7.50	" 3.00	7.10
27.....	" 7.50	" 4.10	8.20
28.....	" 7.50	" 4.10	8.20
29.....	" 7.40	" 4.10	8.30
30.....	" 7.40	" 4.10	8.30
31.....	" 7.40	" 4.10	8.30
Total,			146.10

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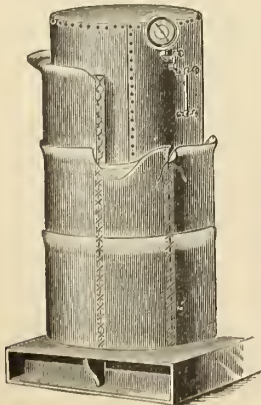
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All Steam Users should see the NEW MICA BOILER AND PIPE COVERING. It is FLEXIBLE, DURABLE, AND A MAGNIFICENT NON-CONDUCTOR OF HEAT.

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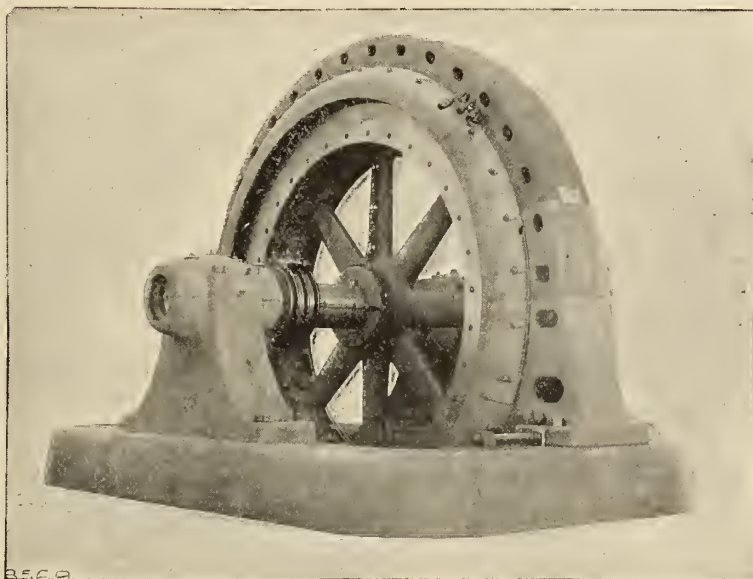
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NELSON, B. C.						



C. G. E. ALTERNATING GENERATOR, REVOLVING FIELD TYPE.

THE WEST KOOTENAY POWER &
LIGHT CO., LIMITED,

have just commenced work on the most important power transmission plant so far undertaken in Canada outside of the immediate neighborhood of the city of Montreal. The distance of transmission is thirty miles, the line potential 20,000 volts, and the amount of power to be developed 8,000 horse power. For this important work the three-phase system of the Canadian General Electric Company has been selected and a contract awarded for the initial installation of 2,000 horse-power. The generators will be of the revolving field type, and of 1,000 h.p. capacity each. In type they will be generally similar to the twelve 1,000 h.p. units now being installed for the Lachine Rapids Hydraulic & Land Co.

SPARKS.

R. C. Tremaine is installing an electric light plant at Exeter, Ont.

A by-law to raise \$10,000 for electric lighting was carried by the ratepayers of Magog, Que., recently.

The Stratford Gas Company are enlarging their electric light plant by installing a 1000 light generator, of the National Company's latest design.

According to Professor Dewar, the best way of ageing a permanent magnet is to dip it several times into liquid air, as it then arrives at a constant condition.

Messrs. Dufton & Sons, woollen mills proprietors of Stratford, are commemorating the jubilee year by refitting their engine room and handsomely decorating their engine, including a very fine royal coat of arms with the motto "Jubilee, 1897."

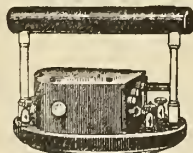
When a person steps on a wire door mat which has been placed before the entrance of the new city market of Springfield, Mass., the doors are opened by electricity. An electric motor using a 110-volt current furnishes the power for winding up a coil spring and closing the door when the circuit is broken by stepping upon the mat, releasing the spring which opens the door.

The Southern Counties Railway Company was granted incorporation at the session of the Dominion parliament just closed. The company propose to build an electric railway from the north of the county of Chambly, Que., through the counties of Vercheres, Rouville, St. Hyacinthe, Laprairie, St. Johns, Iberville, Missisquoi, Brome, Shefford, Stanstead and Sherbrooke, to a point at or near the city of Sherbrooke. The capital stock of the company is limited to \$500,000, and the bonding power per mile has been fixed at \$20,000. Mr. A. J. Coriveau, of Montreal, is one of the promoters of the road.

POSITION WANTED

By practical electrician and engineer; 6 years' experience with light and power plants, direct and alternating systems, 2 and 3-wire; can do all kinds wiring and linework and general repairs; wood like to take charge of plant, or would install new plant. Best of references and certificates as engineer. Married. Age 32. Address, ELECTRIC, care of ELECTRICAL NEWS.

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MAKERS for the Canadian Trade of.....

Electric Bells and Annunciators, Porcelain Pushes, Bronze Pushes, Fire Gongs, Medical Batteries, Family Batteries, Electro-Neurotone, Dominion Patent No. 49,449.

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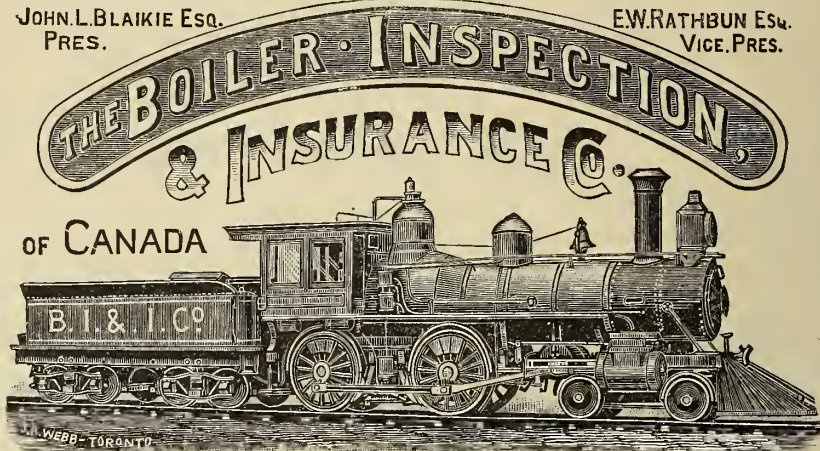
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Are you desirous of purchasing Arc Lighting Machinery, Leather Belting, Water Wheels or Shafting? If so, you cannot afford to miss this opportunity.

Owing to extensions necessitated at our generating station, we are obliged to discard the above mentioned material.

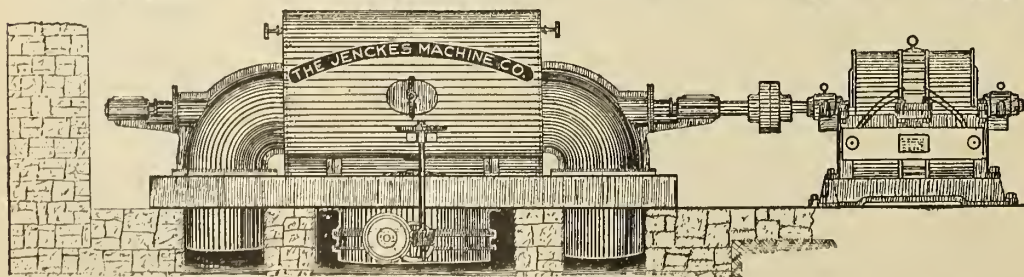
Communicate with us at once for all information and particulars.

The Montmorency Electric Power Co.

— QUEBEC

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THE CROCKER TURBINE



THE accompanying cut shows the direct connection of two 20" CROCKER TURBINES under 50 ft. head to ELECTRICAL GENERATOR at power station of North Shore Power Co., at St. Narcisse, Que.

Two sets were furnished for lighting and power for city of Three Rivers, 17 MILES DISTANT FROM POWER STATION.

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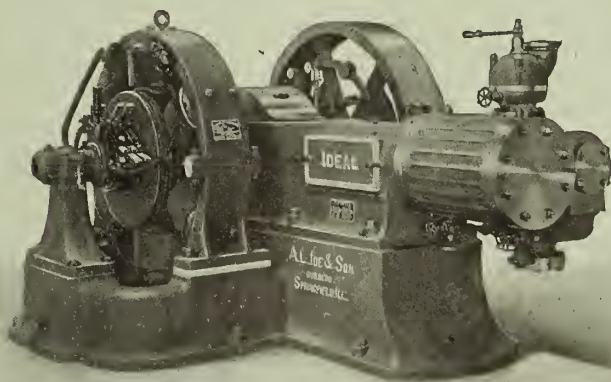


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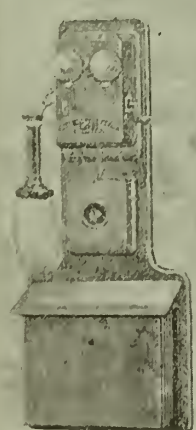
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AUGUST, 1897

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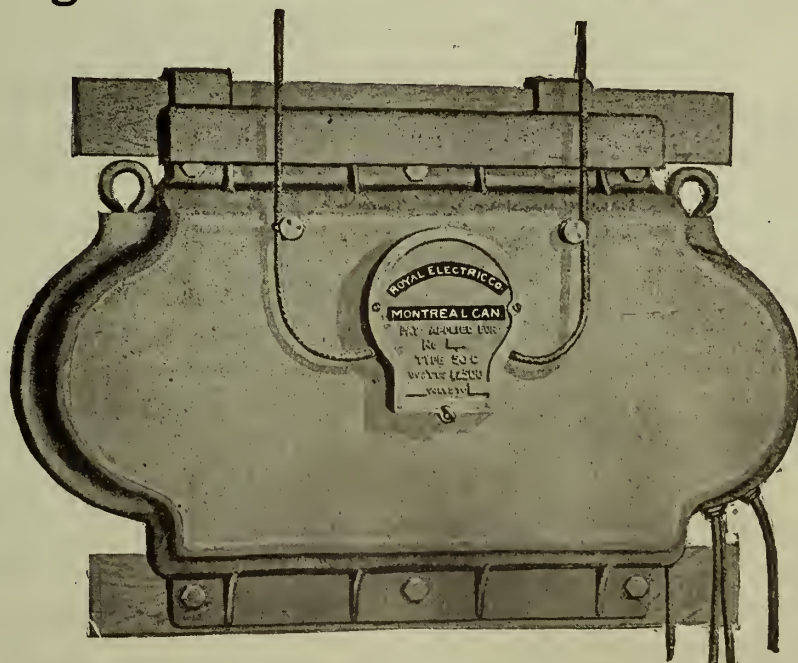
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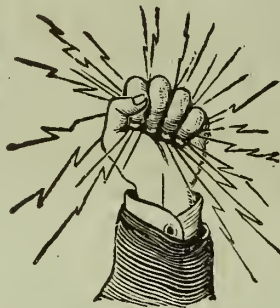
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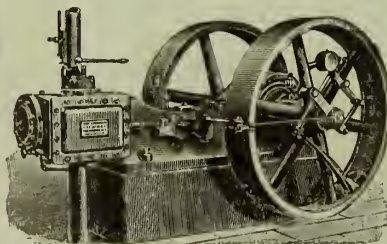
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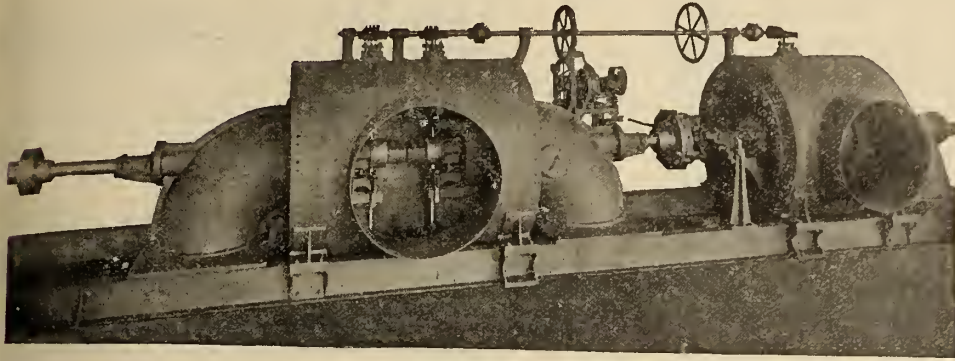
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CANADIAN
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VOL. VII.

AUGUST, 1897

No. 8.

MR. SAMUEL J. T. BROWN.

MEMBERS of the Canadian Electrical Association and persons connected with the electrical interests in Western Ontario will have no difficulty in recognizing in the accompanying portrait the smiling features of Mr. S. J. T. Brown, local manager of the Bell Telephone Co. at London, Ont. Mr. Brown was born in Hertford County, England, on October 3, 1852. In 1869 he came to Canada and settled in Hamilton, where he became engaged in the building business. In 1873 he entered the employ of the Bell Telephone Company under Mr. Hugh C. Baker. In 1883 he was appointed travelling agent to organize exchanges and put in plants in the district west of Kingston. He met with so much success that the company promoted him to the position of manager of the London branch, October, 1891. The numerous improvements in the telephone service in the city since that date are an evidence of the thorough appreciation which he has of his business. Mr. Brown has always taken an active interest in the welfare of the city, and is highly respected by all who know him.

ECONOMY OF ELECTRICAL PRODUCTIONS.

MANY of the commercial chemicals now in general use are made at much cheaper rates than formerly, says an exchange, because of the economy of electrical production. A large percentage of the metals can now be reduced from their ores by electrolytic methods. The production, refining, purifying, etc., of many products not essentially chemical, such, for example, as sugar, molasses, beer, starch, beet-root juice, etc., is now accomplished electrolytically. Cotton is picked and bleached, leather is tanned, white lead is made, meat is preserved, ozone is generated, acetylene gas is produced, safes are broken into, car wheels are tested, graphite is formed, and diamonds are manufactured by either the direct or indirect action of the current; gold, silver, iron, zinc, lead, copper, tin, aluminum, nickel, bismuth, antimony, are all either mined, refined or separated from their ores, and in some cases actually produced by the magical properties of the electric current. Power is transmitted, farms are worked, boats and land carriages are propelled, oil wells are made to increase their flow, the stage is made more spectacular, watercourses are disinfected, and hitherto impenetrable substances are rendered transparent, all

by means of electrical development. The list is not carried beyond the achievements of a year or two past, nor is it meant to include such apparatus as the telephone, telegraph, phonograph, or other widely-spread factors of electrical development.

EDISON'S VIEW OF HORSELESS CARRIAGES.

A REPORTER of a daily paper interviewed Edison recently upon the subject of horseless carriages. His opinion is that the problem rests on the construction of cheaper and lighter motors. Over 2,000 men, he says, are at work in this country alone trying to invent better motors for horseless vehicles. Hundreds of others in Europe are also engaged in the same task. The automobile is bound to be in general use beforelong. Take the bicycle, for instance. The high grade wheels which cost \$100 each to-day will in a few years at best drop to \$50, and machines that can now be bought for from \$50 to \$75 apiece will cost only \$15 or \$20. The same thing will be the outcome of the experiment with horseless carriages. The motors now cost from \$250 to \$350 each. The motors will also be made smaller and can be more easily manipulated. Then tricycles and light load vehicles can be put on the market at a cost of \$100 to \$125 each; a serviceable light vehicle to carry two, or even four, people can be made after the principle of the tricycle at a cost



MR. SAMUEL J. T. BROWN.

of from \$100 to \$125. In the construction of the motor there are three different kinds of power to consider—gas, petroleum and electricity. Electricity should be the best and cheapest. The most successful automobiles made thus far are those in which electric motors are used. They can go twenty-five miles or more without being re-charged at the rate of ten miles an hour. Delivery waggons, express waggons, broughams and all of the heavier class of vehicles can be driven as easily by a storage battery as any other kind if the battery is improved sufficiently, and that will unquestionably be done.

Mr. G. Sage, engineer, Clinton, states on renewing his subscription to the ELECTRICAL NEWS, that no up-to-date engineer can afford to be without it.

The Jenckes Machine Co., of Sherbrooke, recently shipped to the Asbestos & Asbestic Co., of Danville, one of their 20-drill air compressors, together with three high-speed crushing rolls and two picking tables, being a plant required by the Asbestos Co. in connection with the extension of their operations.

TORONTO TECHNICAL SCHOOL EXAMINATIONS.

By the kindness of Mr. James Milne, the instructor in this department, we are enabled to print the answers to the problems given the students in Applied Mechanics at the recent examinations of the above school. The questions were published in the July issue of the ELECTRICAL NEWS, and the answers are as follows:

APPLIED MECHANICS.

ELEMENTARY.

ANSWERS:—

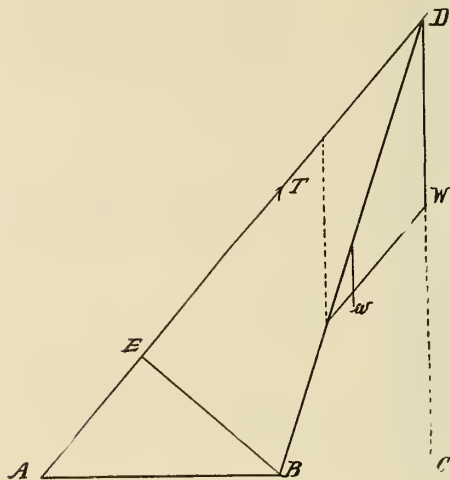
1. $32\frac{2}{3}$ ".
2. 14062.5 ft. pds.
3. 39063 lbs.
4. .718 or 71.8% efficiency.
5. Top 1,000 lbs., bottom, 5,000 lbs., sides 3,000 lbs.
6. B. W. $4740\frac{3}{4}$ lbs. very nearly.
7. 12" and 48" diam. 30 and 120 teeth respectively.
8. 22 cwts. 28 cwts. 11.2 feet from support having 22 cwts. reaction.
9. 15.13 lbs.
10. 200 lbs. $7\frac{1}{2}$ lbs.
11. 55.8 lbs. 896 lbs.
12. 64. 160.

ADVANCED.

13. Let R = Radius of large sheave.
r = radius of small sheave.
P = Pull in lbs.
W = Weight to be lifted.
$$W = \frac{2 P R}{R - r} = 1,200 \text{ lbs.}$$

Efficiency = useful work done. Total work expended.

14.



$$\text{Tension} \times EB = W. \quad BC + w. \frac{BC}{2} = 31 BC.$$

Find EB and BC.

Area of Triangle ABD = 95 sq. ft.

$$\therefore \frac{AD \cdot EB}{2} = 95 \text{ sq. ft.}$$

EB = 7.6 feet.

$$\text{Again } \frac{AB \cdot CD}{2} = 95 \text{ or } CD = 19'$$

But $BC = \sqrt{20^2 - 19^2} = 6\frac{1}{4}'$ nearly

Tension + EB = 31 BC.

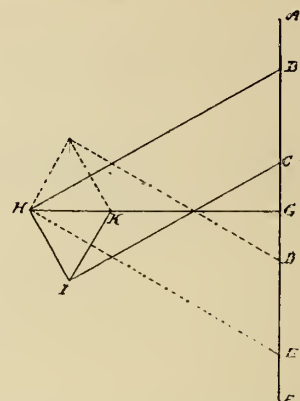
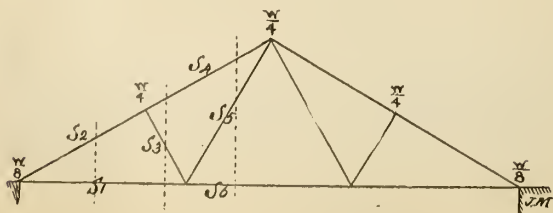
Tension = 25.5 cwts.

By parallelogram of forces the thrust on the gib as measured on diagram is 52.5 cwts.

15. 9,000 lbs.

16. When on the point of lowering the weight is 2380 lbs., and when on the point of raising the weight is 220 lbs.

17.



Let B_1, B_2, B_3 , etc., be the angles, made by

S_1, S_2, S_3 , etc., with the vertical

$$\sin B_2 = \sin B_4 = \cos B_3 = \cos B_5$$

$$\sin B_3 = \sin B_5 = \cos B_2 = \cos B_4$$

and by the method of resolution of forces we get for the section cutting S_1 and S_2 the equations

$$S_1 + S_3 \sin B_2 = 0$$

$$\frac{W}{2} - \frac{W}{8} + S_2 \cos B_2 = 0$$

From which we get $S_1 = 2,600$ and $S_2 = -3,000$ lbs.

If we take a section cutting S_1, S_3, S_4 we get

$$S_1 + S_3 \sin B_3 + S_4 \sin B_4 = 0$$

$$\frac{W}{2} - \frac{W}{8} - \frac{W}{4} - S_3 \cos B_3 + S_4 \cos B_4 = 0$$

$$S_3 = -866 \text{ lbs.}$$

$$S_4 = -2,500 \text{ lbs.}$$

S_5 and S_6 are found in the same manner, viz:

$$S_5 + S_3 \sin B_5 + S_4 \sin B_4 = 0$$

$$\frac{W}{2} - \frac{W}{8} - \frac{W}{4} + S_5 \cos B_5 + \sin \cos B_4 = 0$$

$$S_5 = 866 \text{ lbs.}$$

$$S_6 = 1,732 \text{ lbs.}$$

By construction as shown in the figure we get exactly the same results as measured to scale.

$S_1 = HG = 2,600$ lbs. tension.

$S_2 = HB = 3,000$ lbs. compression.

$S_3 = HI = 866$ lbs. "

$S_4 = IC = 2,500$ lbs. "

$R_5 = IK = 866$ lbs. tension.

$S_6 = KG = 1,732$ lbs. "

18. 360 h. p. nearly.

19. 251 h. p. or 109 h. p. less.

20. Drives No. 1 = 14" Follower No. 1 = 11.2"

" " 2 = 11.92" " " 2 = 13.28"

" " 3 = 9.8" " " 3 = 15.4"

" " 4 = 8.7" " " 4 = 17.5"

21. Tension 12.3 cwts. nearly.

Reaction 8 cwts. fully.

To find the direction of the reaction

Let R_h = horizontal component acting from B to A

R_v = vertical component acting upwards.

By taking moments about A we have

$$\text{Reaction} \times r = W \times 2 + W \times 6$$

$$r = 4\frac{3}{4} \text{ feet.}$$

$\therefore$ with A as centre and $4\frac{3}{4}$ feet radius describe an arc and draw from B a line tangent to this arc. This line represents the direction of the reaction.

22. (a) What 30 teeth makes 7 revolutions.

" 40 " " 3.5 "

(b) " 30 " " 3 " in same direction.

" so " " .5 " in opposite direction.

23. 14.5 tons.

24. 821,200 lbs. nearly. 660 lbs. nearly.

25. 454 revs.

The Kaslo Electric Light Company, of Kaslo, B.C., is about to change its motive power from steam to water power, and has secured a site for a power house about a mile from the town.

The Jenckes Machine Co. have just completed for the Sultana Mine at Rat Portage one 30-stamp mill, with six vanners, one 150 h.p. Corliss engine, with complete equipment of boilers, compressor and hoisting plant. This is the largest and most complete plant of this kind in the Lake of the Woods district.

WESTERN ONTARIO LIGHTING PLANTS.

OUR travelling representative has furnished the following descriptions of lighting plants in Western Ontario, as an adjunct to those which appeared in our July issue :

FERGUS ELECTRIC LIGHT AND POWER COMPANY.

The Fergus electric light and power plant is owned by Dr. Groves, of Fergus, and was installed in 1891, the power house being situated in Dr. Groves' mills. Besides supplying light to Fergus, the company in 1893 extended their line to Elora, and have since supplied that town with street and residential lighting. They also supply power for motors.

The company have at present 24 miles of wire, 800 incandescent lamps and 40 arc street lights. The plant consists of Reliance dynamo of 2080 volts, and Thomson-Houston alternator, all switch-board apparatus being from Reliance works. One of the special features of this plant is the exciting of alternator direct from arc circuit without the use of a separate exciter. There is a well equipped machine shop in connection with the plant furnished with Bertram drill lathe and full complement of tools, in which all repairs are made and arc light winding done. Power is furnished by a Brown tandem-compound, 9 x 14, 24" stroke, and Porter & Allen 10 1/4 x 20 high speed engines, controlled by Porter governor, steam being supplied by two boilers, one 52 in. x 14 ft. and one 48 in. x 14 ft. The engine room is equipped with Northey fire pump and fire hose and an indicator outfit. This plant has had in use a jet condensor, but owing to the hardness of the water they are now putting in a new surface condensor.

Mr. Gibson Groves, the manager of the plant, was born near Fergus on the 20th of June, 1857. After



MR. GIBSON GROVES.

leaving public school he resided for several years in Manitoba, engaging in different lines of business. He always took an active interest in engineering and electrical matters, and in 1893 took charge of the above plant, which, under his progressive and energetic management, has reached a high state of efficiency.

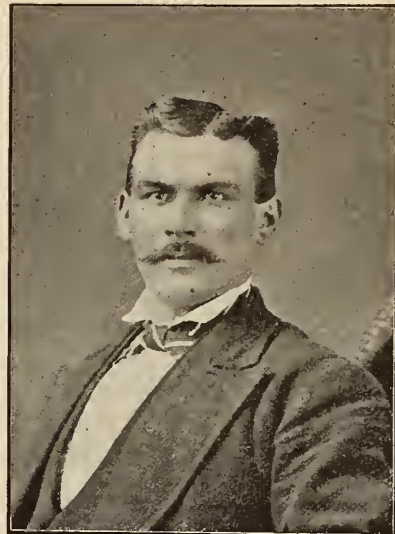
SEAFORTH ELECTRIC LIGHT, HEAT AND POWER COMPANY.

THE plant of the Seaforth Electric Light, Heat & Power Company has been in operation since 1894, and is at present supplying 1,160 incandescent lights, forty-four 1,000 candle power arc and twenty 2,000 c. p. street arc lamps.

The power house is a commodious brick building,

with excellent ventilation, the offices and store-rooms being in the front. The floor of the dynamo room is covered with oil cloth, and the boiler room is built adjoining, with concrete floor. The basement contains toilet and bath room, large water tank and oil filter. Power is generated by a United Electric Improvement Co.'s alternator and Ball arc dynamo. The switch-board is fitted with instruments of same make, with exception of a Carpenter's enamelled rheostat. Two 85 h. p. high speed Robb engines and two 70 h. p. Robb boilers, Austin water heater and Northey pump complete the power apparatus.

Mr. A. H. Ingram, manager for the company, whose portrait we present, has had charge of the plant since



MR. A. H. INGRAM.

its installation. Mr. Ingram is a native Canadian, now 35 years of age, and was born in the county of Huron. After leaving the public schools, and having a liking for mechanical pursuits, he followed engineering, and with the advent of electricity into commercial use, obtained a position with the Brush Company, of Detroit, with which firm he was engaged for over two years, severing his connection with them to take his present position. He operated the plant for about four years for the corporation, and returned to the position when the present company took over the business. He is a progressive and energetic manager. Mr. Ingram now enjoys more than a local reputation, and any visitor to the plant under his charge will be convinced that the reputation he enjoys is well deserved. He is ably assisted by his engineer, Mr. I. Moddlin, and his assistants, Messrs. Darling, Chesney and Smiley.

Under Mr. Ingram's management this company are branching out into the manufacture of dynamos, having already supplied several small plants with generators.

SOUTHAMPTON AND PORT ELGIN ELECTRIC LIGHT PLANT.

Messrs. Kilmer, Cowan & Co., of Southampton, Ont., who have secured a franchise for electric lighting the towns of Southampton and Port Elgin, Ont., are now installing their new plant at Denny's Dam, on the Saugeen river, about 2 1/2 miles north of Southampton, from which they will supply both light and power to above towns.

This firm having purchased the water privilege at what was known as Denny's hull, have erected a two-storey power house, 20 x 38 feet, finished in hardwood, and have rebuilt and enlarged the flume, and are put-

ting in a Kennedy 66 in. special water wheel, with Kennedy governor. They have a 10½ foot head of water, and the privilege to raise to 16 feet, giving them 1,500 h. p. For present lighting they have installed a 75 k. w. monocyclic Canadian General generator, with other instruments. They have at present about fifteen miles of wire, and expect to transmit to other towns in the vicinity. They are using No. 4 wire on the line to Port Elgin and No. 6 to Southampton, and furnish about 1,200 incandescent lights, but are putting in a number of 50 c. p. incandescent street lights.

Mr. C. E. Kilmer, the manager of the plant, is a native Canadian, and an experienced electrician, having had several years experience with the Canadian General Company at Peterboro.

PAISLEY ELECTRIC LIGHT PLANT.

This plant has been operated by water power for about two years, and is owned and managed by Mr. D. McIntyre, of Paisley. The power house is situated on the north branch of the Saugeen river about two miles from the town, and is equipped with a Leffel 52 in. water wheel and a 750 light Royal generator, with instruments, from the Royal Electric Company. For transmitting Mr. McIntyre has already put in about seven miles of wire, and is supplying about 200 lights. With the capacity of the plant it is needless to remark that the citizens of Paisley are getting an efficient service.

ELECTRICITY APPLIED TO GOLD MINING.

THE big power plant at Blue Lakes city, Amador county, Cal., is nearing completion and will shortly be ready to transmit light and power along 32 miles of the mother lode in Amador and Calaveras counties. Large reservoirs have been built in Slabtown, two miles from the site of the power building. Two 2 phase generators will be shipped from Massachusetts, together with the other electrical apparatus, in a few days. It is claimed that this will be 60 per cent. cheaper than the power now used at the mines. The application of electricity to the working of ore is becoming general in all mining regions. Electricity, of New York, says concerning the subject :

"Two important undertakings, which have somewhat recently been before the British investor, have for their object the generation and supply of electrical power for use in gold mining. One of the schemes is for the extensive gold mining districts of Western Australia, particularly the Coolgardie neighborhood, the matter having been gone into very carefully by English experts who have advised the Westralian Electrical Company. It is thought that the growing gold mining industry of Westralia will afford satisfactory instances for the successful application of electric power transmitted over distances.

The other undertaking has been, for some time, in course of carrying out. It is that of the Rand Central Electric Works, which supplies electric power to the gold mines of the Rand district in the South African Republic. The Siemens & Halske Company have been very closely identified with this scheme, but there are a number of English shareholders, Sir Charles Rivers-Wilson being the chairman of the company. The capacity of the plant put down, which is equal to about 2,100 horse power, has been applied for at an average of about £45 per horse-power per annum delivered, including wires and fittings. As this is a cheaper rate than steam power can be obtained it is not very sur-

prising that the demand should have been so ready. The company expects to find it necessary very shortly to extend its plant, and sees its way to good returns on its capital. There are four three-phase generators in position, these being direct-driven by vertical triple-expansion marine-type engines, having a maximum break horse power of 1,200. Each dynamo weighs 30 tons, and is constructed in four pieces. Eight multi-tubular boilers, with 200 tubes each, supply the steam. Each is of 600 horse-power, and has 9,300 square feet of heating surface. Only three sets of the plant will be worked at first, the fourth being held in reserve for a time. Some of the mines supplied are situated over 20 miles from the generating station. Current is generated in the dynamos at 700 volts, is raised by means of step-up transformers to 10,000 volts, and at the mines is reduced by step-down transformers to 120 volts for lighting and 240 to 500 volts for motor work."

H. M. Chance, in a lecture before the Engineers' Club of Philadelphia, not long ago, gave a description of the various processes of extracting gold from ores by electricity. He divided them into six classes, each involving a different principle or method of application. The classes are :

1. Electro-magnetic.
2. Electro-solvent.
3. Electro-amalgamating.
4. Electro-precipitating.
5. Electro-inductional.
6. Electro-smelting.

The first class employs electro-magnets to remove magnetic material from the gold with which it is associated. In the second class the current is used to assist in dissolving the gold from ores by means of chemical solvents of gold. In the third class the current is passed through the amalgamated plates or mercury to facilitate amalgamation. The processes of the fourth class are electrolytic, the gold being electrically deposited from its chemical solutions. These processes are extensively used in South Africa and to some extent in this country. The fifth method aims to remove gold particles from other materials by the inductive action of high frequency alternating currents. The sixth method, that of electric smelting, promises well, provided the cost can be reduced to that of ordinary smelting processes.

THE NEW TELEPHONE GIRL.

SHE was a new girl at the central telephone exchange. Her previous experience in this big and busy world had been behind the counter at Chintz & Chally's. Nevertheless, she was a pleasant-spoken young lady and amiability was written all over her nature. She had adopted as her motto the touching sentence: "We try to please," and she honestly tried to live up to it. There was a ring at the bell. She applied her ear to the instrument and asked, sweetly :

"What number, please?"

"Let me have No. 474."

"I am sorry that No. 474 is busy now," she replied. "You can have No. 473 or No. 475 if you wish."

The individual at the other end of the wire hung up his receiver and used language which plainly showed that all efforts to please do not necessarily succeed.—Harper's Bazaar.

The Electrical Supply Company of Hamilton, Limited, has been incorporated, with a capital of \$20,000. The promoters are: John Wesley Van Dyke, of Grimsby, manufacturer, and John Sintzel, tailor; Joseph Overholt, dentist; William Gilzean Read, merchant, and George Thompson Simpson, electrician, all of Hamilton.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

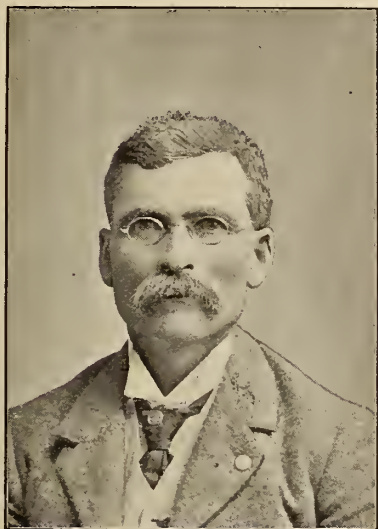
NOTE.—Secretaries of Associations are requested to forward matter for publication in this Department not later than the 25th of each month.

ANNUAL CONVENTION.

THE annual convention of the Canadian Association of Stationary Engineers will be held at Brockville, Ont., on Thursday and Friday, the 19th and 20th instants. The meeting is expected to be especially interesting, as some important questions will be discussed, one being the proposed Dominion license law. A paper on "The Indicator," prepared by Mr. G. B. Risler, of London, will be presented, and it is possible other essays on engineering subjects will be forthcoming.

STRATFORD NO. 3.

The features of the president of the above association, Mr. John Hoy, are herewith portrayed. Mr. Hoy is an active association worker, and puts forth every effort to make the meetings interesting. He was born about ten miles from Stratford, in the township of South East Hope, on September 28th, 1854. At the age of 19 years he learned the trade of machinist, afterwards becoming engineer at the works of Thomp-



MR. JOHN HOY.

son, Williams & Co., remaining in that position for nine years. For a time he was engaged at Weston, Ont., but upon returning to Stratford he accepted the position of engineer for Messrs. Dufton & Sons, which he has occupied for the past thirteen years. He has therefore been in the employ of a steam plant for twenty-three years, and is a thoroughly reliable engineer.

LONDON NO. 5.

The above branch of the C. A. S. E. have made a somewhat new departure in association work. A number of engineering questions have been prepared by the examining committee, a copy of which has been furnished to each member. Three prizes will be awarded to the winners. The questions were prepared by Mr. G. B. Risler, of the Advertiser office, who is also furnishing the prizes. Mr. Potter, chief engineer of the London street railway, will act as judge. The answers are to be received in writing before 8 p. m. of August 19th, and the result is looked forward to with much interest.

BROCKVILLE NO. 15.

Mr. J. Aikens, secretary of Brockville No. 15, writes: At our last meeting the election of officers for the ensuing year was held, with the following result: President,

J. Grundy; past president, A. Franklin; vice-president, C. L. Bertrand; 2nd vice-president, F. Andrews; recording secretary, J. Aikens; financial secretary, Wm. Robinson; treasurer, J. McCaw; conductor, W. S. Baverstock; door-keeper, E. Mortimer; trustees, E. Carr, F. Devine, J. McRitchie; delegates to convention, E. Andrews, F. Wilkinson. The programme for the convention is not yet completed.

ONTARIO ASSOCIATION OF STATIONARY ENGINEERS.

THE annual meeting of the Ontario Association of Stationary Engineers was held in Toronto on Monday, May 31st last. President Arthur Ames, of Brantford, called the meeting to order at 11 a. m.

The minutes of the previous meeting were read and approved, on motion of Bros. Mackie and Devlin. The president delivered the following address:

GENTLEMEN,—On the occasion of our seventh annual meeting, I feel it my duty to thank the officers and members of this association for having shown the confidence reposed in me by re-electing me for a second term to the honorable position as president of the association. It is with the greatest pleasure that I note the growing interest with which our annual meeting is looked forward to by all. I am sure that I but voice the sentiment of all the members when I express the sincere regret occasioned by the absence, through illness, of our worthy registrar, Mr. A. E. Edkins. I am happy to state, however, that he is now convalescent, and we may look forward to seeing him with us again ere long. In his absence, the duties of his position have fallen to Mr. A. M. Wickens, who has so ably taken up the work with all his old-timed vigor, and has managed the business connected with the office in a manner highly creditable to himself and to the society in general, and it must be encouraging to remember how deep an interest the older members still retain in the society.

The business to be brought before you will consist of, as on previous occasions, the election of officers to the board to replace the retiring members whose time have expired. In connection with this matter it is scarcely necessary to impress upon you the importance and desirability of electing, to fill the vacancies, members who have the interests of the association at heart, for, as you will readily understand, its future success as an association depends, to a very great extent, upon the perseverance and intelligence of the officers. In this connection, I may congratulate the officers and members of the outgoing board on the fact that, during the past years, no complaint has reached me respecting any certificate holder, either for neglect of duty, intoxication or other unbecoming conduct, consequently we have not had to revoke any certificates.

I would draw your attention to the fact that the membership of the association has not increased to the extent that it might have during the past year, but it is nevertheless gratifying to note that the best men throughout the province have availed themselves of the privileges offered by the association and procured certificates on their own merits. The importance of this statement is shown by the fact that manufacturers all over the province now require engineers holding Ontario certificates, and every steam plant of any consequence is now managed by a member of this association—a most encouraging sign.

The all important question of legislation is again before us. A short time ago, as you no doubt remember, a joint committee of the Canadian Association and Ontario Association was appointed to draught a bill respecting the inspection of steam boilers and the licensing of engineers in the Dominion. This was done satisfactorily to the committee, and at the meeting in question Messrs. A. M. Wickens, Jas. Devlin and myself were delegated to introduce the bill and explain its purposes. As an association we are deeply indebted to Mr. Jas. Sutherland, M. P. for North Oxford, who so courteously, at our solicitation, consented to introduce the measure in the House, and to draw to the attention of the members of that body the great and increasing importance connected with the proper inspection of steam boilers and the qualifications of the engineers in charge thereof. The bill up to the present time has passed its second reading, which you will be pleased to receive as an assurance that the measure is being duly considered at the hands of the Government. I may say, however, that owing to the great pressure of business at Ottawa connected with the tariff, etc., and owing partially to the introduction of the measure late in the session, the possibilities of securing its passage were lessened, but great hopes are entertained of obtaining the necessary legislation early in the session of 1898.

In conclusion, I wish to once more earnestly and sincerely thank the members of this association for the very great confidence reposed in me and the honor shown me during the time I have held the position of president of this association, and I do this the more earnestly knowing that this is the last opportunity I will have of thanking you individually and collectively for the hearty co-operation and support I have received at your hands in connection with the various duties that have fallen to my position during my term of office. I need hardly say that I will ever have the best interests and welfare of the association at heart, and

should the opportunity ever arise I will be always ready and willing to do all that lies in my power to further its interest to the utmost.

Mr. A. M. Wickins, acting registrar, presented his report. The business of the year was stated to be satisfactory. Regret was expressed that Bro. Edkins was unable to be present. The report also said: The number of new certificates issued for the year of all grades is 76. There have been 17 certificates raised to a higher grade. We have issued 680 certificates, some of which have been cancelled for non-payment of renewals and a few have been blanked by their holders passing to the great beyond, leaving us with 634 certificate holders in good standing. The financial report is as follows:

RECEIPTS.	DISBURSEMENTS.
New Certificates and	To Paid Treasurer.....\$158 47
Raises.....\$200 25	Paid Examination Fees 187 55
Renewals.....229 75	Postage, Printing and
Cash from Treasurer.. 35 00	Legislation.....106 69
	Cash on Hand.....12 29
\$465 00	\$465 00

The treasurer's report showed that \$158.47 had been received from the Registrar, which with the balance on hand May 31, 1896, made an income of \$393.31. The expenditure was as follows:

1896.	
June 1—Board Meeting, Galt	\$ 88 64
Caretaker and Hall Rent.....	3 00
Paid Treasurer Salary.....	10 00
Percentage on Renewals.....	75
6—Paid Registrar.....	25 00
Nov. 26—Paid Registrar.....	35 00
1897.	
Mar. 17—Legislation Committee Expenses.....	44 00
May —Legislation Committee, Expenses to Ottawa....	51 00
May 30—Postage and Expenses.....	3 75
	\$281 14
Balance on Hand.....	111 17
	\$393 31

The standing committees were then appointed as follows: Committee on good of the order—O. P. St. John, F. W. Donaldson, W. G. Blackgrove, Jas. Devlin and John Bain. The legislative committee were re-appointed, and on motion of Bros. Donaldson and Mackie were given power to add to their number. Committee on mileage, Bros. Jas. Devlin, Robt. Mackie and Wm. Sutton.

On motion of Bros. Mackie and Bain, it was resolved that the president be empowered to appoint a member to investigate and report on any boiler explosion that may occur, should he deem it advisable so to do.

It was moved by Bro. Devlin, seconded by T. Elliott, that a petition for a Dominion license law be forwarded to the members in the different towns, with a request to have them circulated, signed and forwarded to Ottawa.

Mr. Mooring moved, seconded by Mr. Wickens, that Bros. Mitchell, Dandie and Bain be appointed a committee on transportation for the next regular meeting at Oshawa.

The treasurer was granted the sum of \$10 for his services.

On motion of Bros. Mitchell and Devlin, a uniform price for inspection of a steam plant, was agreed upon, said price to be \$4 if the plant is situated in the town where such examiner lives; if not, railway fare and hotel expenses to be added.

ELECTION OF OFFICERS.

For president, Bros. T. W. Mitchell and O. P. St. John were nominated, Bro. Mitchell being elected.

For vice-president, Bros. St. John and Donaldson were nominated, the latter being successful.

Bros. Wickens and Mackie were elected by acclamation to the respective offices of registrar and treasurer.

Hamilton, Brantford and Oshawa were all strongly supported by the members as the next meeting place, with the result that Oshawa was decided upon.

On motion of Bros. Devlin and Blackgrove, the regular meeting was fixed for the first Monday after the 24th of May.

ELECTION OF BOARD MEMBERS.

The retiring members of the board were Bros. Mackie, Edkins, Philip and Wickens.

Moved by Bros. Elliott and Donaldson that the retiring members be re-elected by acclamation. Lost.

Nominations were made as follows: Bros. Edkins, St. John, Mackie, Mooring, Philip and Blackgrove.

Upon a vote being taken, Bros. Edkins, Mackie, St. John and Wickens were declared elected.

The standing committee here reported, which was then followed by a report from the committee on mileage, recommending that the sum of \$75.19 be paid board members for mileage.

The committee on the good of the order request all certificate holders to use their best endeavors in setting forth the advantages of taking out certificates, and the usefulness of a Dominion license law to engineers and steam users.

PERSONAL.

Mr. Wm. Cross, C.E., was recently appointed to take charge of the waterworks plant at Calgary, Alta.

Mr. John Davis, of the Metropolitan Railway, North Toronto, has recently passed through a severe illness, from which he is now recovering.

Mr. Fred B. Robb, of Amherst, N.S., was drowned while bathing near Wallace. Deceased was secretary-treasurer of the Robb Engineering Company.

Mr. Wm. F. Chapman, chief engineer for the Canada Carriage Company, Brockville, and executive secretary of the Canadian Association of Stationary Engineers, was recently married to Mrs. Alfred.

TRADE NOTES.

The Lucky Jim Gold Mining Co., of Sandon, B.C., have placed an order with the Jenckes Machine Co., of Sherbrooke, through their Rossland branch, for the ironwork for one three-wheel tramway.

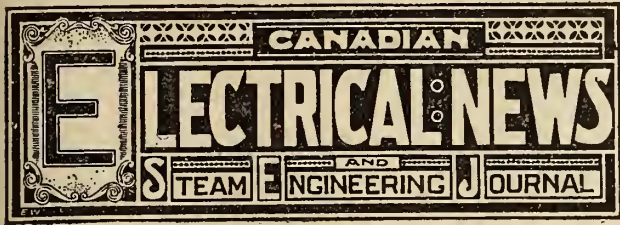
The Colonna Gold Mining Co., of Rossland, are putting in an air pipe line to connect their two properties. This has been bought through the Rossland branch of the Jenckes Machine Co., of Sherbrooke, Que.

We have received a copy of the 1897 circular of information of the International Correspondence School of Electricity, of Scranton, Pa. The thorough system of this school is making for it a world-wide reputation, and those contemplating home study should send for full information.

The Sherbrooke Street Railway Co. have closed a contract with the Jenckes Machine Co. for one of their 45-inch Crocker turbines, with tubing and wheel cases complete, horizontal setting, for direct connection to an electric generator, which is being furnished by the General Electric Co.

The firm of Patterson & Corbin, street car builders, St. Catharines, Ont., has failed. Possession of the estate has been taken by the bank under power of mortgage, while the municipality placed a bailiff in charge for taxes. The firm for several years did a successful trade, but for two or three years past have been at a stand-still.

We are in receipt of an invitation to the nineteenth annual Rhode Island Clam Dinner tendered to the electrical fraternity by Mr. Eugene F. Phillips, president of the Eugene F. Phillips Electrical Works. The event takes place at the Pomham Club, Providence, R. I., on August 21st, and will no doubt prove as enjoyable as similar occasions in the past.



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ADVERTISEMENTS.

Advertising rates sent promptly on application. Orders for advertising should reach the office of publication not later than the 28th day of the month immediately preceding date of issue. Changes in advertisements will be made whenever desired, without cost to the advertiser, but to insure proper compliance with the instructions of the advertiser, requests for change should reach the office as early as the 26th day of the month.

SUBSCRIPTIONS.

The **ELECTRICAL NEWS** will be mailed to subscribers in the Dominion, or the United States, post free, for \$1.00 per annum, 50 cents for six months. The price of subscription should be remitted by currency, registered letter, or postal order payable to C. H. Mortimer. Please do not send cheques on local banks unless 5 cents is added for cost of discount. Money sent in unregistered letters will be at sender's risk. Subscriptions from foreign countries embraced in the General Postal Union \$1.50 per annum. Subscriptions are payable in advance. The paper will be discontinued at expiration of term paid for if so stipulated by the subscriber, but where no such understanding exists, will be continued until instructions to discontinue are received and all arrearages paid.

Subscribers may have the mailing address changed as often as desired. When ordering change, always give the old as well as the new address.

The Publisher should be notified of the failure of subscribers to receive their paper promptly and regularly.

EDITOR'S ANNOUNCEMENTS.

Correspondence is invited upon all topics legitimately coming within the scope of this journal.

The "**Canadian Electrical News**" has been appointed the official paper of the Canadian Electrical Association.

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MONTREAL BRANCH NO. 1.—Meets 1st and 3rd Thursday each month, in Engineers' Hall, Craig street. President, Wm. Smyth; 1st Vice-President, Wm. Bowden; 2nd Vice-President, P. McNaughton; Recording Secretary, J. O'Rourke; Treasurer, G. Jones.

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BRANDON, MAN., BRANCH NO. 1.—Meets 1st and 3rd Friday each month in City Hall. A. R. Crawford, President; Arthur Fleming, Secretary.

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STRATFORD BRANCH NO. 3.—John Hoy, President; Samuel H. Weir, Secretary.

BRANTFORD BRANCH NO. 4.—Meets 2nd and 4th Friday each month. J. B. Forsyth, President; Jos. Ogle, Vice-President; T. Pilgrim, Continental Cordage Co., Secretary.

LONDON BRANCH NO. 5.—Meets on the first and third Thursday in each month in Sherwood Hall. D. G. Campbell, President; B. Bright, Vice-President; W. Blythe, Secretary.

GUELPH BRANCH NO. 6.—Meets 1st and 3rd Wednesday each month at 7.30 p.m. H. Geary, President; Thos. Anderson, Vice-President; H. Flewelling, Rec.-Secretary; P. Ryan, Fin.-Secretary; Treasurer, C. F. Jordan.

OTTAWA BRANCH NO. 7.—Meet every second and fourth Saturday in each month, in Borbridge's hall, Rideau street; Frank Robert, President; T. G. Johnson, Secretary.

DRESDEN BRANCH NO. 8.—Meets 1st and Thursday in each month. Thos. Steeper, Secretary.

BERLIN BRANCH NO. 9.—Meets 2nd and 4th Saturday each month at 8 p.m. J. R. Utley, President; G. Steinmetz, Vice-President; Secretary and Treasurer, W. J. Rhodes, Berlin, Ont.

KINGSTON BRANCH NO. 10.—Meets 1st and 3rd Thursday in each month in Fraser Hall, King street, at 8 p.m. President, F. Simmons; Vice-President, C. Asseltine; Secretary, J. L. Orr.

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ONTARIO ASSOCIATION OF STATIONARY ENGINEERS.

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Information regarding examinations will be furnished on application to any member of the Board.

THE Russian Electro-Technical Society is said to be arranging for an electrical exhibition in St. Petersburg in 1899, at which every kind of electrical device will be granted admission. The expenses are to be borne by the government, the city authorities and the above-named society. This exhibition should be taken advantage of to make known in Russia the merits of Canadian manufactured electrical goods.

Engineering Education.

THE fifth annual meeting of the Society for the Promotion of Engineering Education will be held in the School of Practical Science, Toronto, on the 16th, 17th and 18th of the present month. Special rates have been granted by the railways to delegates to this convention, and a number of pleasure excursions have also been arranged. Mr. Frank Callen, the secretary, may be found at the Arlington Hotel during the convention.

Developments in Telegraphy.

PERSONS connected with the electric lighting and power and telephone interests have shown a disposition to regard the telegraph system as somewhat of a back number. The remark has frequently been heard that the telegraph has reached the limits of its development, and consequently attracts but little notice. Recent developments go to prove, however, that telegraphy is likely to keep fully abreast, if not in advance of improvements in other departments of the electrical field. Reference was recently made in these columns to experiments carried out under the direction of the British post office authorities for telegraphing through space without the aid of wires. Since then the celebrated electrical inventor, Nikola Tesla, of New York, has been devoting his attention to the subject, and claims to have developed apparatus which enables him to telegraph successfully a distance of twenty miles through

the earth. Mr. Tesla has demonstrated to his entire satisfaction by means of the rudimentary apparatus at present at command that communication can be carried on with any part of the globe, and he is about to begin the construction of improved appliances for the accomplishment of this object. The character of these appliances has not been disclosed.

Illumination of Niagara Falls.

THE delegates to the recent convention of the Canadian Electrical Association at Niagara Falls heard from the old residents of that locality descriptions of the beautiful effects which resulted from the illumination of the cataract by means of electricity nearly twenty years ago. Many were the regrets expressed that when the lands surrounding the falls came under the control of the government these artificial effects ceased. Our readers will be interested in knowing that the Acetylene Light, Heat and Power Co. have now in operation a system of illumination by means of acetylene gas. Half inch pipe connects three Naphey generators with fifteen large locomotive headlights placed in various positions. It is said that the light does not penetrate very far, and that no attempt is made to light up the Horse Shoe falls, but only the river close to the American shore.

The Canadian Electrical Association.

THE late convention of the Canadian Electrical Association at Niagara was both interesting and instructive, in that the several papers presented gave rise to especially valuable discussions, and it is gratifying to note that, in these discussions, members associated purely with the operating branch of electricity took part almost as actively as those representing the several manufacturing companies. This evinces a growing interest in the C. E. A. as the representative electrical association of Canada that augurs well for the future of the association, not only as affording yearly a pleasant re-union, but also as an aid in raising the standard of electrical operating by the exchange of experiences and opinions. Such an association should be recognized as an absolute necessity, where, as in the business of electrical lighting and power distribution, the most efficient and economical means of generating and the most remunerative system of operating and managing generally, is not a matter of exact science, but is largely empirical, and varies under different local conditions. Thus it is only by obtaining the views, founded on experience of observers operating under all kinds of varied conditions, that any comprehensive idea can be formed of the most favorable ways of operating.

The Gorge Road.

WE were much impressed on the occasion of the recent electrical conventions at Niagara Falls with the advantages which the Niagara Falls Park and River Railway has over its American rival, known as the "Gorge Road." As most of our readers know, the Canadian road runs close to the edge of the bank of the gorge, and affords a panoramic view of the river and surrounding scenery which is positively delightful. The American road winds along the face of the cliff near its base, the object being to bring sight-seers within as close range as possible of the rapids. The Canadian road enjoys the advantage of being safer for the sight-seer and less costly to maintain in operation. The face of the cliff

out of which a road bed has been cut for the Gorge road has been rendered almost as rotten as pumice stone by being constantly percolated with water. As a result, pieces of rock are continually becoming detached from the upper face of the cliff and falling upon the road-bed of the railway below. To prevent as far as possible accidents from this cause, a staff of fifty workmen is constantly employed in keeping the road-bed in repair. The greatest difficulty is experienced in the spring, at which time the services of several hundred men have sometimes been required. The great expense thus imposed upon the management, coupled with the fact that the period of operation is only about four months each year, makes it extremely doubtful if the enterprise can be made to pay expenses. There is also the possibility, if not probability, that an accident, frightful to contemplate, may some day occur in spite of all the precautions which are or can be taken.

[Since the above was written a collision has occurred on the Gorge road in which nearly twenty persons were injured, some seriously. To allow of repairs being made to one of the tracks both up and down cars were said to be using the inside track.]

Central Station Management.

MR. Armstrong's paper, read at the recent convention of the Canadian Electrical Association, on "Why Some Lighting Plants Do Not Pay," was but the introductory note to a subject on which volumes might well be written, and which we are glad to see is claiming the attention of energetic central station owners. Mr. Armstrong gives, in very unmistakeable language, one of the principal reasons for absence of profits, when he says: "There is no industry representing an equivalent money investment and possibility of public service which is so generally managed by men who know little or nothing about it." In an electric lighting plant we have a factory that contains two perfectly different kinds of machinery, the object of which is to generate an invisible, imponderable force out of so simple a material as coal. Both the steam engine and the electric dynamo are lightly developed scientific machines, and the economical generation of steam in a boiler is thought a fit problem for the attention of highly educated engineers. And yet in the large majority of cases a mechanic, whose education has not included any scientific instruction, and whose experience is limited to repairing broken parts, is placed in the responsible position of manager or electrician. It is not fair to such a man to put him in a position requiring much higher order of technical knowledge and business ability than it is in the least degree possible for him to possess, and the wonder is that central station owners are so blind to their own interests as to follow such a course.

Apparent Inconsistency.

WITHIN the last very few weeks there was a proposition made to appoint an "electrical engineer" on the staff of the city engineer, Hamilton. This proposition was defeated on the ground that such a person was not required, as any mechanic could do the necessary work. Now, the work may, or may not, have been such as to call for the exercise of great technical skill, but the decision seems to indicate the estimation in which engineers are held in Canada. When will the public learn to know the difference between a mechanic and an engineer? They send their sons to McGill or the School of

Practical Science to become electrical engineers, because, as they say, "Electricity is the thing of the future," and they evince their confidence in the advantage of a thoroughly technical and scientific education by preferring the service of a mechanic whose school was the bench and whose technical qualification is the willingness to work for \$40 a month, to those of the certificated graduate whom they themselves have caused to be filled with apparently utterly useless knowledge at considerable expense. Is there really nothing in electrical engineering that is not instinctively known by an uneducated mechanic? Why support such schools as we have in Toronto, Montreal and elsewhere if what they teach is of no value? Why waste time, brains and money in teaching one young man at college what another young man is paid for absorbing unconsciously at a bench? But, on the other hand, if a technical education does specially fit a man for a particular profession, in the name of common sense why not recognize and profit by the probability that he knows more about his work than another man who has made no study of it?

MR. GEORGE BLACK,

SUPERINTENDENT GREAT NORTHWESTERN TELEGRAPH COMPANY, HAMILTON.

THE subject of this sketch was born of Scotch parents in the City of Montreal on June 19th, 1838, in which city he received his education. His ambition was to be an engine builder, but owing to his delicate health his friends deterred him from following that vocation. After spending three years in commercial life he entered the service of the Montreal Telegraph Company as entry clerk, in November, 1854. He was given the option of remaining at the head office or taking an agency, and, choosing the latter, was placed in charge of the St. Hyacinthe, Que., office, working for the G. T. R. and M. T. companies until April, 1855, and in September of the same year was promoted to the Brockville agency, the business of which doubled in the course of a few months. Mr. Black yet speaks of his surprise when one morning the general superintendent called him up and conveyed to him the thanks of the board of directors for the manner in which he had conducted the business of the office, and informed him that an increase in his salary had been decided upon.



MR. GEORGE BLACK.

On October 1st, 1858, Mr. Black was promoted to the management of the Hamilton office, where he remained till the company was merged in the Great Northwestern Company, and since that time he has continued as manager for the new company. So attached was he to his old company that he refused an offer to go into opposition in 1869 at nearly three times the salary he then received. A couple of offers since to leave the service were also declined.

Mr. Black has taken a lively interest in all improvements in telegraphy, and has watched with deep interest the development of electrical inventions and their application to the use of the public. In 1874 he and a friend

invented and applied for an American patent on a method of signalling automatically to and from trains in motion, to prevent accidents, or signal defects in tracks, bridges, etc. This application was killed in the patent office by a mere technicality, no interference being raised which could not be overcome, and though proceedings could have been started over again, the inventors feared that other obstructions would be raised and abandoned the case. This patent anticipated the trolley wire, and when railway collisions are reported Mr. Black always feels that they might have been avoided by the use of his system.

When the Bell telephone came before the public Mr. Black accepted the agency for Hamilton and vicinity, and helped to popularize the new invention by public exhibitions, etc. While experimenting with the telephone he discovered a method of using the telegraph and telephone on the same wire simultaneously. He, in conjunction with Dr. Rosebrugh, of Toronto, patented this method, which was issued in 1878. This was the first method of simultaneous telegraphic telephony invented, and when subsequently improved worked perfectly between Toronto and Hamilton and at other places for a lengthened period. Prof. Rysselberge, of Belgium, got credit and praise for this invention, but his method, which is somewhat similar, was not announced till some years later.

Mr. Black has been a member of the Canadian Electrical Association since its inception, and has been most of the time on its executive committee. He is the local electrical inspector for the Canadian Fire Underwriters.

QUESTIONS AND ANSWERS.

"SUBSCRIBER," Toronto Junction, writes: Would like some information as to where I might obtain a book treating on the design and construction of water turbines; also what kind of machine is used to produce Faradic currents, such as are used for electrical treatment by doctors. Is there any book published on the design of such a machine?

ANSWER.—(1) There are several books treating on turbines, which can be seen in the Public Library, one of the best being Professor Rankin's. (2) Electricity in Electro Therapeutics, by Houston & Kennelly, price about \$1.50, would probably answer your requirements.

BUSINESS MAXIMS FOR ELECTRICAL COMPANIES.

An electrical company in Buffalo has compiled these "Electrical Don'ts." Some good advice is tersely expressed.

Don't try to revolutionize the electrical business by cutting prices. You can't.

Don't expect to get all the jobs you figure on, and get mad if you don't.

Don't expect to make a living on a 10 per cent. margin of profit. You can't.

Don't abuse your competitor because he underbid you. He may lose money and yet do as good work as you.

Don't bid low, do poor work and employ boys to even up. You can't.

Don't educate the embryo electrician and then try to kill him off as soon as he is able to work.

Don't give your work away. What is worth doing is worth getting paid for; and, above all, employ good workmen.

THE NATIONAL ELECTRICAL CODE.

AFTER many months of labor and careful consideration, an electrical code has finally been adopted by the National Board of Fire Underwriters of the United States. The code is identical with that which received the unanimous approval of the Code Committee of the National Conference on Standard Electrical Rules, and is the result of the united efforts of the various electrical, insurance, architectural and allied associations, which have recommended its adoption. These rules received the approval of the National Electric Light Association at its meeting at Niagara Falls in June last, and now, for the first time, a National Electrical Code is issued, stamped with the approval of the insurance as well as the electrical and allied interests. The matter has, we believe, sufficient interest for our readers to warrant the publication of the code :

The following associations have unanimously voted to recommend the code to their respective associations for approval and adoption : American Institute of Architects, American Institute of Electrical Engineers, American Society of Mechanical Engineers, American Street Railway Association, Factory Mutual Fire Insurance Companies, National Association of Fire Engineers, National Board of Fire Underwriters, National Electric Light Association, Underwriters' National Electric Association.

GENERAL PLAN GOVERNING THE ARRANGEMENT OF RULES.

Class A.—Central Stations, Dynamo, Motor and Storage Battery Rooms, Transformer Sub-Stations, etc. Rules 1 to 11.

Class B.—Outside Work, all systems and voltages. Rules 12 and 13.

Class C.—Inside work. Rules 14 to 39. Sub-divided as follows : General Rules, applying to all systems and voltages. Rules 14 to 17.

Constant-Current Systems. Rules 18 to 20.

Constant-Potential Systems. All voltages : Rules 21 to 23. Voltage not over 300 : Rules 24 to 31. Voltage between 300 and 3,000 : Rules 32 to 37. Voltage over 3,000 : Rules 38 to 39.

Class D.—Specifications for Wires and Fittings. Rules 40 to 55.

Class E.—Miscellaneous. Rules 56 to 59.

Class F.—Marine Wiring. Rules 60 to 72.

GENERAL SUGGESTIONS.

In all electric work, conductors, however well insulated, should always be treated as bare, to the end that under no conditions, existing or likely to exist, can a grounding or short circuit occur, and so that all leakage from conductor to conductor, or between conductor and ground, may be reduced to the minimum.

In all wiring special attention must be paid to the mechanical execution of the work. Careful and neat running, connecting, soldering, tapping of conductors and securing and attaching of fittings, are specially conducive to security and efficiency, and will be strongly insisted on.

In laying out an installation, except for constant-current systems, the work should, if possible, be started from a centre of distribution, and the switches and cut-outs, controlling and connected with the several branches, be grouped together in a safe and easily accessible place, where they can be readily got at for attention or repairs. The load should be divided as evenly as possible among the branches, and all complicated and unnecessary wiring avoided.

The use of wire-ways for rendering concealed wiring permanently accessible is most heartily endorsed and recommended ; and this method of accessible concealed construction is advised for general use.

Architects are urged, when drawing plans and specifications, to make provision for the channeling and pocketing of buildings for electric light or power wires, and in specifications for electric gas lighting to require a two-wire circuit, whether the building is to be wired for electric lighting or not, so that no part of the gas fixtures or gas piping be allowed to be used for the gas lighting circuit.

CLASS A.—STATIONS AND DYNAMO ROOMS.

Includes Central Stations, Dynamo, Motor and Storage Battery Rooms, Transformer Sub-Stations, Etc.

1. GENERATORS—

a. Must be located in a dry place.

b. Must never be placed in a room where any hazardous process is carried on, nor in places where they would be exposed to inflammable gases or flyings of combustible materials.

c. Must be insulated on floors or base frames, which must be kept filled to prevent absorption of moisture, and also kept clean and dry. Where frame insulation is impracticable, the Inspection Department having jurisdiction may, in writing, permit its omission, in which case the frame must be permanently and effectively grounded.

A high-potential machine which, on account of great weight or for other reasons, cannot have its frame insulated from the ground, should be surrounded with an insulated platform. This may be made of wood, mounted on insulating supports, and so arranged that a man must always stand upon it in order to touch any part of the machine.

In case of a machine having an insulated frame, if there is trouble from static electricity due to belt friction, it should be overcome by placing near the belt a metallic comb connected with the earth, or by grounding the frame through a very high resistance of not less than 200 ohms per volt generated by the machine.

d. Every constant-potential generator must be protected from excessive current by a safety fuse, or equivalent device, of approved design in each lead wire.

These devices should be placed on the machine or as near it as possible.

Where the needs of the service make these devices impracticable, the Inspection Department having jurisdiction may, in writing, modify the requirements.

e. Must each be provided with a waterproof cover.

f. Must each be provided with a name-plate, giving the maker's name, the capacity in volts and amperes, and normal speed in revolutions per minute.

2. CONDUCTORS—

From generators to switch-boards, rheostats or other instruments, and thence to outside lines.

a. Must be in plain sight or readily accessible.

b. Must have an approved insulating covering as called for by rules in Class "C" for similar work, except that in central stations, on exposed circuits, the wire which is used must have a heavy braided non-combustible outer covering.

Bus bars may be made of bare metal.

c. Must be kept so rigidly in place that they cannot come in contact.

d. Must in all other respects be installed under the same precautions as required by rules in Class "C" for wires carrying a current of the same volume and potential.

3. SWITCHBOARDS—

a. Must be so placed as to reduce to a minimum the danger of communicating fire to adjacent combustible material.

Special attention is called to the fact that switchboards should not be built down to the floor, nor up to the ceiling, but a space of at least ten or twelve inches should be left between the floor and the board, and from eighteen to twenty-four inches between the ceiling and the board, in order to prevent fire from communicating from the switchboard to the floor or ceiling, and also to prevent the forming of a partially concealed space very liable to be used for storage of rubbish and oily waste.

b. Must be made of non-combustible material or of hardwood in skeleton form, filled to prevent absorption or moisture.

c. Must be accessible from all sides when the connections are on the back, but may be placed against a brick or stone wall when the wiring is entirely on the face.

d. Must be kept free from moisture.

e. Bus bars must be equipped in accordance with rules for placing conductors.

4. RESISTANCE BOXES AND EQUALIZERS—(For construction rules see No. 52.)

a. Must be placed on a switchboard, or, if not thereon, at a distance of a foot from combustible material, or separated therefrom by a non-inflammable, non-absorptive insulating material.

5. LIGHTNING ARRESTERS—(For construction rules see No. 55.)

a. Must be attached to each side of every overhead circuit connected with the station.

It is recommended to all electric light and power companies that arresters be connected at intervals over systems in such numbers and so located as to prevent ordinary discharges entering (over the wires) buildings connected to the lines.

b. Must be located in readily accessible places away from combustible materials, and as near as practicable to the point where the wires enter the building.

Station arresters should generally be placed in plain sight on the switchboard.

In all cases, kinks, coils and sharp bends in the wires between

the arresters and the out-door lines must be avoided as far as possible.

c. Must be connected with a thoroughly good and permanent ground connection by metallic strips or wires having a conductivity not less than that of a No. 6 B. & S. copper wire, which must be run as nearly in a straight line as possible from the arresters to the earth connection.

Ground wires for lightning arresters must not be attached to gas pipes within the buildings.

It is often desirable to introduce a choke coil in circuit between the arresters and the dynamo. In no case should the ground wire from a lightning arrester be put into iron pipes, as these would tend to impede the discharge.

6. CARE AND ATTENDANCE—

a. A competent man must be kept on duty where generators are operating.

b. Oily waste must be kept in approved metal cans and removed daily.

Approved waste cans shall be made of metal, with legs raising can three inches from the floor, and with self-closing covers.

7. TESTING OF INSULATION RESISTANCE—

a. All circuits must be provided with reliable ground detectors. Detectors which indicate continuously, and give an instant and permanent indication of a ground, are preferable. Ground wires from detectors must not be attached to gas-pipes within the building.

b. Where continuously indicating detectors are not feasible, the circuits should be tested at least once per day, and preferably oftener.

c. Data obtained from all tests must be preserved for examination by the Inspection Department having jurisdiction.

These rules on testing to be applied at such places as may be designated by the Inspection Department having jurisdiction.

8. MOTORS—

a. Must be insulated on floors or base frames, which must be kept filled to prevent absorption of moisture; and must be kept clean and dry. Where frame insulation is impracticable the Inspection Department having jurisdiction may, in writing, permit its omission, in which case the frame must be permanently and effectively grounded.

A high potential machine which, on account of great weights or for other reasons, cannot have its frame insulated, should be surrounded with an insulated platform. This may be made of wood, mounted on insulating supports, and so arranged that a man must stand upon it in order to touch any part of the machine.

In case of a machine having an insulated frame, if there is trouble from static electricity due to belt friction, it should be overcome by placing near the belt a metallic comb connected to the earth, or by grounding the frame through a very high resistance or not less than 200 ohms per volt generated by the machine.

b. Must be wired under the same precautions as required by rules in Class "C", for wires carrying a current of the same volume and potential.

The leads or branch circuits should be designed to carry a current at least fifty per cent. greater than that required by the rated capacity of the motor to provide for the inevitable over-loading of the motor at times without over-fusing the wires.

c. The motor and resistance box must be protected by a cut-out and controlled by a switch (see No. 17a) said switch plainly indicating whether "on" or "off". Where one-quarter horsepower or less is used on low tension circuits a single pole switch will be accepted. The switch and rheostat must be located within sight of the motor, except in such cases where special permission to locate them elsewhere is given, in writing, by the Inspection Department having jurisdiction.

d. Must have their rheostats or starting boxes located so as to conform to the requirements of Rule 4.

In connection with motors the use of circuit breakers, automatic starting boxes and automatic under-load switches is recommended, and they must be used when required.

e. Must not be run in series-multiple or multiple-series.

f. Must be covered with a water-proof cover when not in use, and if deemed necessary by the Inspection Department having jurisdiction, must be enclosed in an approved case.

From the nature of the question the decision as to what is an approved case must be left to the Inspection Department having jurisdiction to determine in each instance.

g. Must, when combined with ceiling fans, be hung from insulated hooks, or else there must be an insulator interposed between the motor and its support.

h. Must each be provided with a name-plate, giving the maker's name, the capacity in volts and amperes and the normal speed in revolutions per minute.

9. RAILWAY POWER PLANTS—

a. Must be equipped in each feed wire before they leave the station with an approved automatic circuit breaker (see No. 44) or other device, which will immediately cut off the current in case of a ground. This device must be mounted on a fireproof base, and in full view and reach of the attendant.

10. STORAGE OR PRIMARY BATTERIES—

a. When current for light and power is taken from primary or secondary batteries, the same general regulations must be observed as applied to similar apparatus fed from dynamo generators developing the same difference of potential.

b. Storage battery rooms must be thoroughly ventilated.

c. Special attention is directed to the rules for rooms where acid fumes exist. (See No. 24, j and k.)

d. All secondary batteries must be mounted on non-absorptive, non-combustible insulators, such as glass or thoroughly vitrified and glazed porcelain.

e. The use of any metal liable to corrosion must be avoided in connections of secondary batteries.

11. TRANSFORMERS—(For construction rules see No. 54.)

a. In central or sub-stations the transformers must be so placed that smoke from the burning out of the coils or the boiling over of the oil (where oil filled cases are used) could do no harm.

CLASS B.—OUTSIDE WORK.

All Systems and Voltages.

12. WIRES—

a. Service wires must have an approved rubber insulating covering. (See No. 40a.) Line wires, other than services, must have an approved weather-proof, or rubber insulating covering. (See No. 40 a and b.) All tie wires must have an insulation equal to that of the conductors they confine.

b. Must be so placed that moisture can not form a cross connection between them not less than a foot apart, and not in contact with any substance other than their insulating supports. Service blocks must be covered over their entire surface with at least two coats of waterproof paint.

c. Must be at least seven feet above the highest point of flat roofs, and at least one foot above the ridge of pitched roofs over which they passed or to which they are attached.

d. Must be protected by dead insulated guard iron or wires from possibility of contact with other conducting wires or substances to which current may leak. Special precautions of this kind must be taken where sharp angles occur, or where any wires might possibly come in contact with electric light or power wires.

e. Must be provided with pecticoat insulators of glass or porcelain. Porcelain knobs or cleats and rubber hooks will not be approved.

f. Must be so spliced or joined as to be both mechanically and electrically secure without solder. The joints must then be soldered, to insure preservation, and covered with an insulation equal to that on the conductors.

All joints must be soldered, even if made with some form of patent splicing device. This ruling applies to joints and splices in all classes of wiring covered by these rules.

g. Must, where they enter buildings, have drip loops outside, and the holes through which the conductors pass must be bushed with non-combustible, non-absorptive insulating tubes slanting upward toward the inside.

h. Telegraph, telephone and similar wires must not be placed on the same cross-arm with electric light or power wires.

i. The metallic sheathes to cables must be permanently and effectively connected to "earth".

TROLLEY WIRES.

j. Must not be smaller than No. 0 B. & S. copper or No. 4 B. & S. silicon bronze, and must readily stand the strain put upon them when in use.

k. Must have a double insulation from the ground. In wooden pole construction, the pole will be considered as one insulation.

l. Must be capable of being disconnected at the power plant, or of being divided into sections, so that, in case of fire on the railway route, the current may be shut off from the particular section and not interfere with the work of the firemen. This rule also applies to feeders.

m. Must be safely protected against accidental contact where crossed by other conductors.

Guard wires should be insulated from the ground and should be electrically disconnected in sections of not more than 300 feet in length.

GROUND RETURN WIRES.

n. For the diminution of electrolytic corrosion of underground metal work, ground return wires must be so arranged that the difference of potential between the grounded dynamo terminal and any point on the return circuit will not exceed twenty-five volts.

It is suggested that the positive pole of the dynamo be connected to the trolley line, and that whenever pipes or other underground metal work are found to be electrically positive to the rails or surrounding earth, that they be connected by conductors arranged so as to prevent as far as possible current flow from the pipes into the ground.

13. TRANSFORMERS—(For construction rules see No. 54.)

a. Must not be placed inside of any building, excepting central stations, unless by special permission of the Inspection Department having jurisdiction.

b. Must not be attached to the outside walls of buildings, unless separated therefrom by substantial supports.

CLASS C.—INSIDE WORK.

All Systems and Voltages.

GENERAL RULES.—ALL SYSTEMS AND VOLTAGES.

14. WIRES—(For special rules see Nos. 18, 24, 32, 38 and 39.)

a. Must not be of smaller size than No. 14 B. & S., except as allowed under rules 24u and 40c.

b. Tie wires must have an insulation equal to that of the conductors they confine.

c. Must be so spliced or joined as to be both mechanically and electrically secure without solder; they must then be soldered to insure preservation, and the joint covered with an insulation equal to that on the conductors.

Stranded wires must be soldered before being fastened under clamps or binding screws, and when they have a conductivity greater than No. 10 B. & S. copper wire, they must be soldered into lugs.

All joints must be soldered, even if made with some form of patent splicing device. This ruling applies to joints and splices in all classes of wiring covered by these rules.

d. Must be separated from contact with walls, floors, timbers or partitions through which they may pass by non-combustible, non-absorptive insulating tubes, such as glass or porcelain.

Bushings must be long enough to bush the entire length of the hole in one continuous piece, or else the hole must first be bushed by a continuous water-proof tube, which may be a conductor, such as iron pipe; the tube then is to have a non-conducting bushing pushed in at each end so as to keep the wire absolutely out of contact with the conducting pipe.

e. Must be kept free from contact with gas, water of other metallic piping, or any other conductors or conducting material which they may cross, by some continuous and firmly fixed non-conductor, creating a separation of at least one inch. Deviations from this rule may sometimes be allowed by special permission.

f. Must be so placed in wet places that an air space will be left between conductors and pipes in crossing, and the former must be run in such a way that they cannot come in contact with the pipe accidentally. Wires should be run over, rather than under, pipes upon which moisture is likely to gather or which, by leaking, might cause trouble on a circuit.

15. UNDERGROUND CONDUCTORS—

a. Must be protected, when brought into a building, against moisture and mechanical injury, and all combustible material must be kept removed from the immediate vicinity.

b. Must not be so arranged as to shunt the current through a building around any catch-box.

16. TABLE OF CARRYING CAPACITY OF WIRES—

Below is a table showing the allowable carrying capacity of wires containing ninety-eight per cent. pure copper, which must be followed in placing interior conductors:

TABLE A. Rubber Covered Wires. See No. 4 a.		TABLE B. Weatherproof Wires. See No. 4b	
B. & S. G.	Amperes.		Amperes.
18.....	3.....	5.....	5
16.....	6.....	6.....	8
14.....	12.....	10.....	16
12.....	17.....	12.....	23
10.....	24.....	14.....	32
8.....	33.....	16.....	46
6.....	46.....	18.....	65
5.....	54.....	20.....	77
4.....	65.....	22.....	92
3.....	76.....	24.....	110
2.....	90.....	26.....	131
1.....	107.....	28.....	156
0.....	127.....	30.....	185
00.....	150.....	32.....	220
000.....	177.....	34.....	262
0000.....	210.....	36.....	312

Circular Mills.	Amperes.	Amperes.
200,000.....	200.....	300
300,000.....	270.....	400
400,000.....	330.....	500
500,000.....	390.....	590
600,000.....	450.....	680
700,000.....	500.....	760
800,000.....	550.....	840
900,000.....	600.....	920
1,000,000.....	650.....	1,000
1,100,000.....	690.....	1,080
1,200,000.....	730.....	1,150
1,300,000.....	770.....	1,220
1,400,000.....	810.....	1,290
1,500,000.....	850.....	1,360
1,600,000.....	890.....	1,430
1,700,000.....	930.....	1,490
1,800,000.....	970.....	1,550
1,900,000.....	1,010.....	1,610
2,000,000.....	1,050.....	1,670

The lower limit is specified for rubber-covered wires to prevent gradual deterioration of the high insulations by the heat of the wires, but not from fear of igniting the insulation. The question of drop is not taken into consideration in the above tables.

The carrying capacity of sixteen and eighteen wire is given, but no smaller than fourteen is to be used, except as allowed under Rules 24u and 40c.

17. SWITCHES, CUT-OUTS, CIRCUIT BREAKERS, ETC.—(For construction rules, see Nos. 43, 44 and 45.)

a. Must, whenever called for, unless otherwise provided (for exceptions, see No. 8c and No. 22c), be so arranged that the cut-outs will protect, and the opening of the switch or circuit breaker will disconnect, all of the wires; that is, in a two-wire system the two wires, and in a three-wire system the three wires, must be protected by the cut-out and disconnected by the operation of the switch or circuit breaker.

b. Must not be placed in the immediate vicinity of easily ignitable stuff or where exposed to inflammable gases or dust or to flyings of combustible material.

c. Must, when exposed to dampness, either be inclosed in a waterproof box or mounted on porcelain knobs.

CONSTANT CURRENT SYSTEMS.

Principally Series Arc Lighting.

18. WIRES—(See also No. 14, 15 and 16.)

a. Must have an approved rubber insulating covering. (See No. 40a.)

b. Must be arranged to enter and leave the building through an approved double-contact service switch (see No. 43,) mounted in a non-combustible case, kept free from moisture, and easy of access to police or firemen. So-called "snap switches" must not be used on high potential circuits.

c. Must always be in plain sight, and never incased, except when required by the Inspection Department having jurisdiction.

d. Must be supported on glass or porcelain insulators, which separate the wire at least one inch from the surface wired over, and must be kept rigidly at least eight inches from each other, except within the structure of lamps, on hanger-boards, in cut-out boxes, or like places, where a less distance is necessary.

e. Must, on side walls, be protected from mechanical injury by a substantial boxing, retaining an air space of once-inch around the conductors, closed at the top (the wires passing through bushed holes), and extending not less than seven feet from the floor. When crossing floor-timbers in cellars or in rooms, where they might be exposed to injury, wires must be attached by their insulating supports to the under side of a wooden strip not less than one-half an inch in thickness.

19. ARC LAMPS—(For construction rules, see No. 49.)

a. Must be carefully isolated from inflammable material.

b. Must be provided at all times with a glass globe surrounding the arc, securely fastened upon a close base. No broken or cracked globes are to be used.

c. Must be provided with a wire netting (having a mesh not exceeding one and one-quarter inches) around the globe, and an approved spark arrester (see No. 50), when readily inflammable material is in the vicinity of the lamps, to prevent escape of sparks, melted copper or carbon. It is recommended that plain carbons, not copper-plated, be used for lamps in such places.

Arc lamps, when used in places where they are exposed to flyings of easily inflammable material, should have the carbons inclosed completely in a globe in such manner as to avoid the necessity for spark arresters.

For the present, globes and spark arresters will not be required on so-called "inverted arc" lamps, but this type of lamp must not be used where exposed to flyings of easily inflammable materials.

d. Where hanger-boards (see No. 48) are not used, lamps must be hung from insulating supports other than their conductors.

20. INCANDESCENT LAMPS IN SERIES CIRCUITS—

- a. Must have the conductors installed as provided in Rule No. 18, and each lamp must be provided with an automatic cut-out.
- b. Must have each lamp suspended from a hanger-board by means of rigid tube.
- c. No electro-magnetic device for switches and no system of multiple-series or series-multiple lighting will be approved.
- d. Under no circumstances can they be attached to gas fixtures.

CONTINUED—POTENTIAL SYSTEMS.

General Rules—All Voltages.

21. AUTOMATIC CUT-OUTS (Fuses and Circuit Breakers.) (See No. 17, and for construction, Nos. 44 and 45.)

a. Must be placed on all service wires, either overhead or underground, as near as possible to the point where they enter the building and inside the walls, and arranged to cut off the entire current from the building.

Where the switch required by Rule No. 22 is inside the building, the cut-out required by this section must be placed so as to protect it.

b. Must be placed at every point where a change is made in the size of wire [unless the cut-out in the larger wire will protect the smaller. (See No. 16)].

c. Must be in plain sight, or enclosed in an approved box (see No. 46), and readily accessible. They must not be placed in the canopies or shells of fixtures.

d. Must be so placed that no set of incandescent lamps, whether grouped or one fixture or several fixtures or pendants, requiring a current of more than six amperes, shall be dependent upon one cut-out. Special permission may be given in writing by the Inspection Department having jurisdiction for departure from this rule in cases of large chandeliers.

e. Must be provided with fuses, the rated capacity of which does not exceed the allowable carrying capacity of the wire, and when circuit breakers are used, they must not be set more than about thirty per cent. above the allowable carrying capacity of the wire, unless a fusible cut-out is also installed in the circuit (see No. 16).

22. SWITCHES—(See No. 17, and for construction, No. 43.)

a. Must be placed on all service wires, either overhead or underground, in a readily accessible place, as near as possible to the point where the wires enter the building, and arranged to cut off the entire current.

b. Must always be placed in dry, accessible places, and be grouped as far as possible. Knife switches must be so placed that gravity will tend to open rather than close the switch.

c. Must not be single-pole, except when the circuits which they control supply not more than six sixteen candle-power lamps or their equivalent.

d. Where gangs of flush switches are used, whether with conduit systems or not, the switches must be inclosed in boxes constructed of or lined with fire resisting material. Where two or more switches are placed under one plate, the box must have a separate compartment for each switch. No push buttons for bells, gas lighting circuits or the like shall be placed in the same wall plate with switches controlling electric light or power wiring.

23. ELECTRIC HEATERS—

a. Must, if stationary, be placed in a safe situation, isolated from inflammable materials and be treated as sources of heat.

b. Must each have a cut-out and indicating switch (see No. 17a).

c. Must have the attachments of feed wires to the heaters in plain sight, easily accessible and protected from interference, accidental or otherwise.

d. The flexible conductors for portable apparatus, such as irons, etc., must have an approved insulating covering (see No. 40c, 3).

e. Must each be provided with name-plate, giving the maker's name and the normal capacity in volts and amperes.

LOW POTENTIAL SYSTEMS.—300 Volts or Less.

Any circuit attached to any machine, or combination of machines, which develops a difference of potential between any two wires of over ten volts and less than 300 volts, shall be considered as a low potential circuit, and as coming under the class, unless an approved transforming device is used, which cuts the difference of potential down to ten volts or less. The primary circuit not to exceed a potential of 3,000 volts.

24. WIRES—General Rules. (See also Nos. 14, 15 and 16.)

a. Must not be laid in plaster, cement or similar finish.

b. Must never be fastened with staples.

c. Must not be fished for any great distance, and only in places where the inspector can satisfy himself that the rules have been complied with.

d. Twin wires must never be used, except in conduits, or where flexible conductors are necessary.

e. Must be protected on side walls from mechanical injury. When crossing floor timbers in cellars or in rooms, where they might be exposed to injury, wires must be attached by their insulating supports to the under side of a wooden strip, not less than one-half inch in thickness, and not less than three inches in width.

Suitable protection on side walls may be secured by a substantial boxing, retaining an air space of one inch around the conductor, closed at the top (the wires passing through bushed holes), and extending not less than five feet from the floor; or by an iron-armored or metal-sheathed insulating conduit sufficiently strong to withstand the strain it will be subjected to; or plain metal pipe, lined with insulating tubing which must extend one-half inch beyond the end of the metal tube.

The pipe must extend not less than five feet above the floor, and may extend through the floor in place of a floor bushing.

If iron pipes are used with alternating currents, the two or more wires of a circuit must be placed in the same conduit. In this case the insulation of each wire must be reinforced by a tough conduit tubing projecting beyond the ends of the iron pipe at least two inches.

f. When run immediately under roofs, or in proximity to water tanks or pipes, will be considered as exposed to moisture.

SPECIAL RULES.

For open work, in dry places:

g. Must have an approved rubber or weather-proof insulation. (See No. 40a and b.)

h. Must be rigidly supported on non-combustible, non-absorptive insulators, which separate the wire at least one-half inch from the surface wired over, and they must be kept apart at least two and one-half inches.

Rigid supporting requires under ordinary conditions, where wiring along flat surfaces, supports at least every four and one-half feet. If the wires are liable to be disturbed, the distance between supports should be shortened. In buildings of mill construction, mains of No. 8 B. & S. wire or over, where not liable to be disturbed, may be separated about four inches, and run from timber to timber, not breaking around, and may be supported at each timber only.

This rule will not be interpreted to forbid the placing of the neutral of a three-wire system in the centre of a three-wire cleat, provided the outside wires are separated two and one-half inches.

In damp places, such as breweries, packing houses, stables, dye houses, paper or pulp mills, or buildings specially liable to moisture or acid or other fumes liable to injure the wires or their insulation, except where used for pendants:

i. Must have an approved rubber insulating covering (see No. 40a).

j. Must be rigidly supported on non-combustible, non-absorptive insulators, which separate the wire at least one inch from the surface wired over, and they must be kept apart at least two and one-half inches.

Rigid supporting requires under ordinary conditions, where wiring over flat surfaces, supports at least every four and one-half feet. If the wires are liable to be disturbed, the distance between supports should be shortened. In buildings of mill construction, mains of No. 8 B. & S. wire or over, where not liable to be disturbed, may be separated about four inches and run from timber to timber, not breaking around, and may be supported at each timber only.

k. Must have no joints or splices.

For moulding work:

l. Must have approved rubber insulating covering (see No. 40a).

m. Must never be placed in moulding in concealed or damp places.

For conduit work:

n. Must have an approved rubber insulating covering (see No. 40e).

The use of concentric wire (see No. 40e) is recommended in preference to twin conductors.

o. Must not be drawn in until all mechanical work on the building has been, as far as possible, completed.

p. Must not have wires of different circuits drawn in the same conduit.

q. Must, for alternating systems, have the two or more wires of a circuit drawn in the same conduit.

It is advised that this be done for direct-current system also, so that they may be changed to alternating systems at any time, induction troubles preventing such a change unless this construction is followed.

For so-called concealed work :

- r. Must have an approved rubber insulating covering (see No. 40a).
- s. Must be rigidly supported on non-combustible, non-absorptive insulators which separate the wire at least one inch from the surface wired over, and must be kept at least ten inches apart, and, when possible, should be run singly on separate timbers or studding.

Rigid supporting requires under ordinary conditions, where wiring along flat surfaces, supports at least every four and one-half feet. If the wires are liable to be disturbed, the distance between supports should be shortened.

- t. When from the nature of the case it is impossible to place concealed wiring on non-combustible insulating supports of glass or porcelain, the wires, if not exposed to moisture, may be fished on the loop system if encased throughout in approved continuous flexible tubing or conduit.

For fixture work :

- u. Must have an approved rubber insulating covering (see No. 40d), and shall not be less in size than No. 18 B. & S.
- v. Supply conductors, and especially the splices to fixture wires, must be kept clear of the grounded part of gas pipes, and, where shells are used, the latter must be constructed in a manner affording sufficient area to allow this requirement.
- w. Must, when fixtures are wired outside, be so secured as not to be cut or abraded by the pressure of the fastenings or motion of the fixture.

25. INTERIOR CONDUITS—(See also Nos. 24n to q, and 41).

The object of a tube or conduit is to facilitate the insertion or extraction of the conductors to protect them from mechanical injury and, as far as possible, from moisture. Tubes or conduits are to be considered merely as raceways, and are not to be relied upon for insulation between wire and wire, or between the wire and the ground.

- a. Must be continuous from one junction box to another or to fixtures, and the conduit tube must properly enter all fittings.
- b. Must be first installed as a complete conduit system, without the conductors.
- c. Conduits must extend at least one-half inch beyond the finished surface of walls or ceilings, except that, if the end is threaded and a coupling screwed on, the conduit may be left flush with the surface, and the coupling may be removed when work on building is completed.
- d. Must, after conductors are introduced, have all outlets plugged with special wood or fibrous plugs, made in parts, and the outlet then sealed with approved compound. Joints must be made air-tight and moisture-proof.
- e. Must have the metal of the conduit permanently and effectually grounded.

26. FIXTURES—(See also No. 24u to w.)

- a. Must, when supported from the gas piping of a building, be insulated from the gas-pipe system by means of approved insulating joints (see No. 51) placed as close as possible to the ceiling.

It is recommended that the gas outlet pipe be protected above the insulating joint by a non-combustible, non-absorptive insulating tube, having a flange at the lower end where it comes in contact with the insulating joint; and that, where outlet tubes are used, they be of sufficient length to extend below the insulating joint, and that they be so secured that they will not be pushed back when the canopy is put in place. Where iron ceilings are used, care must be taken to see that the canopy is thoroughly and permanently insulated from the ceiling.

- b. Must have all burrs, or fins, removed before the conductors are drawn into the fixture.
- c. The tendency to condensation within the pipes should be guarded against by sealing the upper end of the fixture.
- d. No combination fixture in which the conductors are concealed in a space less than one-fourth inch between the inside pipe and the outside casing will be approved.
- e. Must be tested for "contacts" between conductors and fixtures, for "short circuits" and for ground connections before it is connected to its supply conductors.
- f. Ceiling blocks of fixtures should be made of insulating material; if not, the wires in passing through the plate must be surrounded with non-combustible, non-absorptive, insulating material, such as glass or porcelain.

27. SOCKETS—(For construction rules, see No. 47.)

- a. In rooms where inflammable gases may exist the incandescent lamp and socket must be enclosed in a vapor-tight globe, and supported on a pipe-hanger, wired with approved rubber-covered wire (see No. 40a) soldered directly to the circuit.
- b. In damp or wet places, or over specially inflammable stuff, waterproof sockets must be used.

When waterproof sockets are used, they should be hung by separate stranded rubber-covered wires, not smaller than No. 14 B. & S., which should preferably be twisted together when the drop is over three feet. These wires should be soldered direct to the circuit wires, but supported independently of them.

28. FLEXIBLE CORD—

- a. Must have an approved insulation and covering (see No. 40c.)
- b. Must not be used as a support for clusters.
- c. Must not be used except for pendants, wiring of fixtures and portable lamps or motors.
- d. Must not be used in show windows.
- e. Must be protected by insulating bushings where the cord enters the socket.
- f. Must be so suspended that the entire weight of the socket and lamp will be borne by knots under the bushing in the socket, and above the point where the cord comes through the ceiling block or roseette, in order that the strain may be taken from the joints and binding screws.

29. ARC LIGHTS ON LOW-POTENTIAL CIRCUITS—

- a. Must have a cut-out (see No. 17a) for each lamp or each series of lamps.

The branch conductors should have a carrying capacity about fifty per cent. in excess of the normal current required by the lamp to provide for heavy current required when lamp is started or when carbons become stuck without over-fusing the wires.

- b. Must only be furnished with such resistances or regulators as are inclosed in non-combustible material, such resistances being treated as sources of heat. Incandescent lamps must not be used for resistance devices.
- c. Must be supplied with globes and protected by spark arrestors and wire netting around globe, as in the case of arc lights on high-potential circuits. (See Nos. 19 and 50.)

30. ECONOMY COILS—

- a. Economy and compensator coils for arc lamps must be mounted on non-combustible, non-absorptive insulating supports, such as glass or porcelain, allowing an air space of at least one inch between frame and support, and in general to be treated like sources of heat.

31. DECORATIVE SERIES LAMPS—

- a. Incandescent lamps run in series shall not be used for decorative purpose inside of buildings, except by special permission in writing from the Inspection Department having jurisdiction.

HIGH-POTENTIAL SYSTEMS.

300 to 3,000 Volts.

Any circuit attached to any machine, or combination of machine, which develops a difference of potential, between any two wires, of over 300 volts and less than 3,000 volts, shall be considered as a high-potential circuit, and as coming under that class, unless an approved transforming device is used, which cuts the difference or potential down to 300 volts or less.

32. WIRES—(See also Nos. 14, 15 and 16.)

- a. Must have an approved rubber insulating covering. (See No. 40a.)
- b. Must be always in plain sight and never incased, except where required by the Inspection Department having jurisdiction.
- c. Must be rigidly supported on glass or porcelain insulators, which raise the wire at least one inch from the surface wired over, and must be kept apart at least four inches for voltages up to 750 and at least eight inches for voltages over 750.

Rigid supporting requires under ordinary conditions, where wiring along flat surfaces, supports at least about every four and one-half feet. If the wires are unusually liable to be disturbed, the distance between supports should be shortened.

In buildings of mill construction, mains of No. 8 B. & S. wire or over, where not liable to be disturbed, may be separated about six inches for voltages up to 750 and about ten inches for voltages above 750; and run from timber to timber, not breaking around, and may be supported at each timber only.

- d. Must be protected on side walls from mechanical injury by a substantial boxing retaining an air space of one inch around the conductors, closed at the top (the wires passing through lashed holes) and extending not less than seven feet from the floor. When crossing floor timbers, in cellars or in rooms, where they might be exposed to injury, wires must be attached by their insulating supports to the under side of a wooden strip not less than one-half an inch in thickness.

33. TRANSFORMERS (When permitted inside buildings, see No. 13)—(For construction rules, see No. 54.)

- a. Must be located at a point as near as possible to that at which the primary wires enter the building.
- b. Must be placed in an inclosure constructed of or lined with fire-resisting material; the inclosure to be used only for this purpose, and to be kept securely locked and access to the same allowed only to responsible persons.
- c. Must be effectually insulated from the ground and the inclosure in which they are placed must be practically air-tight, except that it shall be thoroughly ventilated to the outdoor air, if possible, through a chimney or flue. There should be at least six inches air space on all sides of the transformer.

34. CAR WIRING—

a. Must be always run out of reach of the passengers, and must have an approved rubber insulating covering. (See No. 40a.)

35. CAR HOUSES—

a. Must have the trolley wires securely supported on insulating hangers.

b. Must have the trolley hangers placed at such a distance apart that, in case of a break in the trolley wire, contact can not be made with the floor.

c. Must have cut-out switch located at a proper place outside of the building, so that all trolley circuits in the building can be cut out at one point, and line circuit breakers must be installed, so that when this cut-out switch is open the trolley wire will be dead at all points within 100 feet of the building. The current must be cut out of the building whenever the same is not in use or the road not in operation.

d. Must have all lamps and stationary motors installed in such a way that one main switch can control the whole of each installation—lighting or power—independently of main feeder-switch. No portable incandescent lamps or twin wire allowed, except that portable incandescent lamps may be used in the pits, connections to be made by two approved rubber-covered flexible wires (see No. 40a), properly protected against mechanical injury; the circuit to be controlled by a switch placed outside of the pit.

e. Must have all wiring and apparatus installed in accordance with rules under Class "C" for constant potential systems.

f. Must not have any system of feeder distribution centering in the building.

g. Must have the rails bonded at each point with not less than No. 2 B. & S. annealed copper wire; also a supplementary wire to be run for each track.

h. Must not have cars left with trolley in electrical connection with the trolley wire.

36. LIGHTING AND POWER FROM RAILWAY WIRES—

a. Must not be permitted, under any pretense, in the same circuit with trolley wires with a ground return, except in electric railway cars, electric car houses, and their power stations, nor shall the same dynamo be used for both purposes.

37. SERIES LAMPS—

a. No system of multiple-series or series-multiple for light or power will be approved.

b. Under no circumstances can lamps be attached to gas fixtures.

EXTRA HIGH-POTENTIAL SYSTEMS.

Over 3,000 Volts.

Any circuit attached to any machine or combination of machines, which develops a difference of potential, between any two wires, of over 3,000 volts, shall be considered as an extra high potential circuit, and as coming under that class, unless an approved transforming device is used, which cuts the difference of potential down to 3,000 volts or less.

38. PRIMARY WIRES—

Must not be brought into or over buildings, except power and substations.

39. SECONDARY WIRES—

a. Must be installed under rules for high-potential systems, when their immediate primary wires carry a current at a potential of over 3,000 volts.

The high line insulation required for extra high-potential current tends to make the insulation resistance between primary and secondary coils of transformers a comparatively weak point, and lightning discharges would be apt to take this path to the earth. With the present means of protection against transformer break-downs and the consequent liability of secondary wiring being subjected to the strain of the primary current, it is not deemed advisable to permit a primary current with a potential of over 3,000 volts without an intermediate step-down transformer. The presence of wires carrying a current at a potential of over 3,000 volts in the streets of cities and towns is also considered as increasing the fire hazard.

(To be Continued.)

The New York and New Haven Railway Company recently adopted what is known as the third rail system on a branch line of railway thirteen miles long. The electric power for the motors is carried along the track by a special rail laid between the two, on which the cars run. The "electrified" rail weighs 100 pounds to the yard, and is shaped like a wedge, with a flat top. This affords a large conductive body, with plenty of surface for the "shoes" which convey the current to the motors to act upon. Insulation is provided by simple blocks of wood, which, to the surprise of the experts, have been found to answer perfectly well, the loss of current being practically insignificant. At crossings, switches and stations the current is conducted underground, while an ingenious automatic arrangement, operated by electricity, provides compressed air to operate a whistle for signalling.

SPARKS.

Mr. E. B. Tree, of Woodstock, Ont., has invented a rotary engine.

William Davidson is supplying two 50-horse power boilers for the Exhibition Association of Halifax, N.S.

The Exeter Electric Light and Power Company has been organized at Exeter, Ont., with a capital of \$10,000. The provisional board is composed of C. Lutz, president; R. C. C. Tremaine, B. A. Sc., manager; B. S. O'Neill, E. J. Spackman and Frank Woods.

The Gas and Water Company, of Sherbrooke, Que., have reduced the price of electric lighting from \$1 per 100 amperes to 75 cents, with a further reduction of 15 cents on payment within 15 days. This is practically 60 cents for a 16-candle power lamp burning 100 hours.

The New York post office is laying underground postal tubes this summer for distribution of letters. The tubes will be eight inches in diameter, and carriers capable of containing 500 letters each will be forced through them by power furnished by an electric plant in the General Postoffice.

The Canadian Locomotive and Engine Company, of Kingston, Ont., are now making steel pipes under patents held by Mr. F. A. Williams, of Wolverton, England. Tests of the pipes were recently made in the presence of a number of experts, and are said to have been entirely satisfactory.

The Dominion Electric Heating and Supply Company, of Ottawa, have elected the following officers: President, Andrew Holland; vice-president, Thomas Askwith; secretary-treasurer, J. I. McCracken; directors, Chas. A. Carriere, A. Trudeau, P. MacGregor, Geo. Low and B. H. Bell.

A syndicate of capitalists are said to be negotiating for the purchase of the Chemong and Lakefield lines of the Grand Trunk Railway, with a view of converting them into electric systems. For the present the scheme is kept somewhat in the dark, but definite information is looked for at an early date.

The Lachine Rapids Hydraulic and Land Company, of Montreal, have made a reduction of 33½ per cent. in the rate charged for electric power. This brings the price to one-half cent per 16 candle-power lamp per hour, and is claimed to be the cheapest rates charged in any city the size of Montreal in the world. The company have lately issued \$500,000 of six per cent. debentures, redeemable in ten years. These were issued among the stockholders only, each of whom were allowed to take debentures to the amount of 50 per cent. of the stock held.

The Dominion Government has completed forty miles more of the telegraph line on the north shore of the St. Lawrence, from the former terminus at Pointe Esquimaux, and an office has been opened at Plastre Bay. It is intended to extend the line forty-four miles more this summer, to Natashquan, where an office will be opened this fall. The north shore line will still be about 250 miles from Belle Isle, its objective point, and it is the intention to complete this section as rapidly as possible, so that the entrance to the Straits of Belle Isle will be in direct telegraphic communication with Quebec and Montreal.

A car "fender," the design of the manager, Mr. J. W. Moyes, has been adopted by the Metropolitan Street Railway. The fender, which is 5 feet 8 inches by 2 feet 6 inches, and lies without rocking about three inches above the rails, hangs on two perpendicular strings, instead of horizontal ones, and its braces are attached to the main body of the car. There is consequently no recoil, and whatever the fender picks up it holds, as was demonstrated when the car ran at a considerable speed into a flock of sheep, coming in the opposite direction. A point in its favor is that it can be folded up while on the car, to the saving of much valuable room in a motor shed.

A sextuplex telegraph wire was successfully operated in a telegraph office in Boston a few days ago. The circuit was to New Haven and return, a distance of 300 miles. Three different messages were sent over the wire simultaneously, and were easily and accurately received on the receiving side. The inventor of the new scheme is Mr. Thomas B. Dixon, of Kentucky, son of the late former Senator Archibald Dixon, of that state. He is a practical telegrapher, and has been trying to solve the problem of the sextuplex since 1891. The telegraphic world has long been familiar with a duplex wire, which will transmit one message each way at the same time, and latter with the quadruplex, with which it is possible to send two messages each way at the same time. The new sextuplex will transmit three messages each way at once.

WATER HAMMER.

A DESCRIPTION of some experiments upon the causes of steam pipe explosions, made to an engineering society, shows under what conditions water hammer may be expected in steam pipes and under what conditions it becomes dangerous. The tests were made upon steam pipes 6" in diameter and .197" thick. The ends were closed by flanges and provided with drain cocks and air relief-cocks, and suitable pressure gauges that would record to 2133 pounds, one on the end flange and one on the top of the pipe. The pipe was inclined upward, and entering the bottom flange was a steam pipe with a valve, so that if any water was in the pipe the entering steam must pass through it.

The second experiment was conducted upon 12" pipe, $\frac{1}{4}$ " thick, with four pressure gauges, steam being supplied at the bottom through a 3" pipe. The position of this pipe was afterwards considerably changed. The tests made were as follows :

1. Pipe without water, air cock closed and the drain cock open.
2. Pipe without water, air cock open and the drain cock closed.
3. Pipe without water, air and drain cocks open.
4. Pipe without water, air and drain cocks closed.
5. Vacuum in pipe and some condensed water formed by creating vacuum, air and drain cocks closed.
6. Vacuum in pipe, and the latter filled with water to about one-third of its cubic capacity, so that the point where the steam entered was under water in the first pipe, it being made to incline toward that point. In the second pipe the water filled the bottom of the pipe. Air and drain cocks were closed to one-third of their capacity at one end, and running into nothing at the other end.
7. Pipe without vacuum filled with water as under 6, air and drain cocks closed.
8. Pipe without vacuum filled with water the same as under 6, air and drain cocks open.

In the experiments with the first pipe, steam was admitted from a boiler under 70 pounds pressure, by rapidly opening the stop valve on the main steam pipe, the influx of steam having been regulated beforehand by adjusting the valve close to the experimental pipe. Beginning with one-fifth of the area of this valve the opening was increased one-fifth in each of the succeeding tests, the whole tests being frequently repeated to check results. In carrying out tests 1 to 4 no motion was observed, whether the filling of the pipe with steam was retarded or accelerated. The pipe became heated slowly or quickly, according to the rapidity with which it filled with steam, until it became thoroughly warmed, and the pressure gauges on the pipes showed same as boiler. As soon as vacuum formed and a small amount of condensed water was present in the pipe (test No. 5), light hammering was present in the pipe when steam was admitted. This was not, however, indicated on the gauges, but caused a slight movement of the pipes. This hammering and backward and forward movement of the pipe became more intense the greater the quantity of water present (tests 6 and 7), manifesting itself in distinct blows at short intervals, and causing the gauges to show between 126 to 242 pounds. Whether the vacuum in the pipe (test 6) had any influence on the action of the steam when admitted, could not be determined by any of the trials.

The heaviest hammering, as well as the greatest

movement of the pipe—which also continued for some length of time—were observed when the pipe was about one-third full of water, and both the air and drain cocks kept open (test No. 8) and for all five openings of the valve. During these tests there was a uniform discharge of water from the drain cock and of air from the air cock, for a longer or shorter time, depending on the opening of the stop valve in the pipe. For instance, with one-fifth opening of the stop valve the first hammering was noticeable after four minutes ; at three-fifths opening, after 30 seconds ; and 15 seconds after the valve was wide open, powerful hammering and violent motion of the pipe set in, in each case accompanied by an impulsive discharge of water and air and later by steam from the air and drain cocks. These phenomena are due to the fact that the steam is condensed by the water present, and only when the water has attained the temperature of steam does the impulsive action of the latter set in. The pressures observed on the gauges at the end of each trial (test No. 8) fluctuated between 284 and 1066 pounds. At one time the greatest pressure would be observed on the gauge tapped in the flange at end of pipe, and then on the gauge on side of pipe.

The second experimental pipe was changed somewhat from time to time, but showed no radical change in results.

As a result of these tests it is shown that destruction of a completely drained, though entirely cool, pipe cannot occur, whether the stop valve near the boiler under steam is opened gradually or in a sudden, careless manner, because hammering, which alone can cause an explosion, does not follow. But it is to be observed that a rapid filling of the pipes with steam may prove disastrous, for the sudden heating up of the various parts may cause rupture, due to unequal stresses on and resistance of the material.

When, however, a large quantity of water is contained in the pipes and the steam is forced to find its way through it and to carry it along, an explosion may occur, even if the stop valve is opened in the slowest and most careful manner. If there is so little water in the pipe that steam need not force its way through it, no disastrous hammering will occur, nor will the water present be carried along by the steam when the stop valve is opened, as was demonstrated by the amount of water left in the pipe after the end of all tests. The results of the tests with the first arrangement of the second experimental pipe lead to the conclusion that where water has accumulated in U bends of pipes, if the stop valve is opened gradually, the entering steam will distribute itself at once uniformly over the surface of the water, and by virtue of its pressure, in spite of the original condensation, it is not only maintained but steadily increased, and will prevent any agitation of the water, and, consequently, hammering. If, however, a sudden change of pressure and a rapid influx of steam occur, then the water will be agitated and, once in motion, it will cause violent and dangerous hammering in the pipe. Therefore, steam pipes with pockets are to be avoided. The variations of the pressures indicated in the gauges after all the tests leads to the conclusion that the water is thrown backwards and forwards, wave-motion like, caused by the influx of steam, and that the pressure is greater or less, depending on the intensity with which the moving mass of water strikes the opening to which the gauge is attached.

ELECTRIC RAILWAY DEPARTMENT.

MR. CLYDE K. GREEN.

It was our pleasure about three years ago to present to readers of the *ELECTRICAL NEWS* a portrait of Mr. Clyde K. Green, who at that time was electrician for the Hamilton, Grimsby and Beamsville Railway. Mr. Green having since received a promotion in the electric railway field, we again reproduce his portrait, with some particulars of his life.

Mr. Green was born across the border, in the state of Michigan, and after leaving school, engaged in the hardware business at Waterford, Ont., leaving there to accept a position with the Edison Company, of Peterboro', in their electrical works, where he obtained a practical knowledge of electrical manufacturing and was promoted to the position of assistant foreman. On the conversion of the Toronto Street Railway to an electrical system, Mr. Green was offered and accepted the position of foreman of the armature department of that road. His success in this direction having attracted



MR. CLYDE K. GREEN.

the attention of the management of the Hamilton, Grimsby and Beamsville Electric Railway, he was offered the position of electrician, fulfilling the duties in an eminently satisfactory manner.

In February of this year he accepted the management of the Hamilton Radial Electric Railway Company.

It might not be amiss to mention a few particulars in regard to this road. The tracks at present cover a distance of eleven miles, extending from Hamilton to Burlington, by way of Burlington Beach. The rolling stock consists of four very handsomely fitted motor cars, each equipped with four G.E. 1000 motors, two at each end of the car, with double trucks, and guaranteed to make 38 miles an hour. The cars are fitted with regular railroad seats with rattan covering, and have a smoking compartment at rear end. The company have, besides the above motors, baggage cars and trailers for use of excursions and pic-nics. One of the special features of this road is the swing bridge over the canal at Burlington Beach, which is operated by an electric motor and which has worked very satisfactorily.

The International Radial Railway Company, of Hamilton, are reported to have sold \$30,000 worth of stock, and to be waiting until they can dispose of as much more, before commencing the construction of the road.

TORONTO STREET RAILWAY ASSESSMENT CASE.

A DECISION of interest to street railway companies has been given by Judge McDougall.

Last summer a board of county judges decided against the assessment of the Toronto Street Railway Company's rails, poles and wires, and the Court of Revision refused, on the strength of this judgment, to confirm the assessment of the plant of the company in the first, fifth and sixth wards. The City Law Department decided to make a test case and appealed in the name of Controller Lamb and of the Assessment Commissioner against the decision of the Court of Revision in regard to the assessment of \$103,500 in the sixth ward. Mr. Fullerton and Mr. Drayton prosecuted the appeal for the city, and Mr. Laidlaw, for the company, urged lack of jurisdiction.

Judge McDougall delivered a judgment last week, the logical sequence of which will be the assessment by municipal officers all over Ontario of all the rails, poles, wires, mains, etc., which have in many cases up to the present time been exempt.

TROLLEYS GAINING IN ENGLAND.

THE prejudice against overhead wires is fast melting away in Great Britain, as evidenced by the following from a London daily :

"The long controversy as to the best form of mechanical traction for tramways in our large cities seems to be gradually deciding itself in favor of the overhead electric trolley system. This method has already been adopted in several towns, and the corporation of Glasgow has now resolved to give it a trial, after a year or two of deliberation, since it acquired the local tramways. The Tramways Committee has been authorized to spend about twenty thousand pounds on the establishment of the system on an experimental route, that is, on an isolated section of the lines, about two and one-half miles in length."

There are still some old fossils who are afraid of shadows, as witness the following extract from an open letter in another London paper of about the same date :

"Among the many objections against the introduction of the overhead system is one that I particularly noticed in the working of the said system in the city of Toronto, viz., that as the cars pass along the roads the connecting rod from the top of the car where it joins the overhead wire is continually giving off bright sparks, sufficient to frighten nervous people with the fear of possible danger, and also to startle nervous horses."

Blinders on the "connecting rod," or a pair of blue goggles for the "nervous" writer, might solve the difficulty.

Mr. C. C. Kramp, Woodstock, Ont., in remitting his subscription to the *NEWS*, writes: "Am well pleased with the paper. It is welcome every month."

Mr. B. B. Osler, president of the Hamilton and Dundas Railway, states that the conversion of the road to electricity is being delayed by the failure to obtain running privileges over the Hamilton Street Railway Company's tracks within the city limits.

EDUCATIONAL DEPARTMENT

INTRODUCTORY

After mature deliberation the publisher of this journal has decided to devote a certain amount of space each month to what may be termed an Educational Department, wherein both mechanical and electrical formula and mathematical problems will be discussed, illustrated, and as far as possible rule and example given. At the request of the editor, I have with pleasure undertaken to contribute to this department regularly each month, and before discussing actual mathematical problems, wish to briefly introduce the subject at issue.

The primary object of this department is chiefly to increase the value of an already valuable paper, by placing in the hands of every engineer who has any knowledge of the rudimentary principles of mathematics, such matter as will enable him by a little study to master the most intricate mechanical and electrical formula. Many of our most valuable engineering works and publications from time to time contain formula that is in many cases but vaguely understood, and very often entirely misunderstood, thus rendering an otherwise valuable work practically valueless to the reader.

Just at what particular point our calculations should commence became a matter of serious thought, and past experience had to be carefully considered, bearing in mind the fact that there are many really good engineers whose early education has, through force of circumstances, been deficient, and many others who, through lack of opportunity, have not been able to review their early education for years. Knowing by observation and experience the great necessity of having a thorough elementary education before attempting to digest and calculate problems, and the almost utter impossibility of the student arriving at a satisfactory conclusion of his studies without a thorough knowledge of the principle of mathematics involved, I have decided to commence at a point and carry out the programme outlined in this journal—commencing at the foundation and advancing by easy stages until the principles underlying the most obtuse and difficult formula can be readily explained and easily understood. The advantages to be derived from an education of this kind, coupled with practical mechanical ability, is too well understood to require comment.

The programme which has been outlined for the succeeding nine months will embrace:

DECIMAL FRACTIONS—Definitions and explanation of principles of, and method of reduction to common fractions, and vice versa.

SQUARE AND CIRCULAR MEASURE—Definition and explanation and practical demonstrations of.

CUBICAL AND CYLINDRICAL MEASUREMENTS—Definitions and explanations of, with practical hints.

SQUARE AND CUBE ROOT—Definitions and explanations of.

SAFETY VALVE CALCULATIONS—(Spring and Lever Types)—Principles of, with practical demonstrations.

BOILER CONSTRUCTION—Stays, rivets, joints and seams, iron and steel plate—strength of, with formula and practical demonstrations.

It is not the intention to fill these columns with a mass of figures hastily compiled without reference to any particular object; on the contrary, every problem will be carefully thought out, and only such information given as will be of use to you, and an effort will be made, based on experience and a knowledge of the requirements, to make his series of tests complete in every particular.

WM. THOMPSON.

[ARTICLE IV.]

EVOLUTION.

EVOLUTION is the process of finding the root of any number, and is of frequent occurrence in engineers' calculations.

The most important and only cases which I shall refer to is the process of finding the square or cube root of any number.

Example (1): Find the square root of 1521. In formula this is written $\sqrt{1521}$.

$$\begin{array}{r} 15.21(39 \\ 9 \\ 69. \overline{) 621} \\ \underline{621} \\ \dots \end{array}$$

Beginning at the right hand figure 1, count two figures to the left and mark the second as shown in the example, take the figures to the left of this mark 15 and find what number multiplied by itself will give fifteen; there is no number that will do this, since $3 \times 3 = 9$ is too small and $4 \times 4 = 16$ is too large; we therefore take the one that is too small, viz., 3, and place it in the quotient, placing its square 9 under the 15 marked off in the number and subtract, and bring down the next two figures 21, making new dividend 621. To get the new divisor multiply the quotient 3 by 2 = 6, and place as a trial divisor at the left of the dividend 621; find how many times this is contained in the dividend, discarding the last figure on the right; 6 is then contained in 62 nine times. Since we cannot pass this point, we place 9 in the quotient and also in the divisor; then we multiply the whole divisor 69 by this number (9) and place the product under the dividend and subtract. Having no remainder, root is now complete and found to be 39. If we require proof of this we simply square the number, thus:

$$\begin{aligned} 39 \times 39 &= 1521 \\ \text{then } 39^2 &= 1521 \\ \text{and } \sqrt{1521} &= 39 \end{aligned}$$

Example (2): Find the square root of 366.

$$\begin{array}{r} 3.66(19.131126 \\ 1 \\ 29 \overline{) 266} \\ \underline{261} \\ 381 \overline{) 5.00} \\ \underline{381} \\ 3823 \overline{) 11900} \\ \underline{11469} \\ 38261 \overline{) 43100} \\ \underline{38261} \\ 382621 \overline{) 483900} \\ \underline{382621} \\ 3826222 \overline{) 10127900} \\ \underline{7652444} \\ 38262246 \overline{) 247445600} \\ \underline{229573476} \\ 17872124 \end{array}$$

In this example we proceed to mark off as before and get as our quotient the whole number 19, but since there is still a remainder our root cannot be complete; we proceed as before, but since there remains no more figures in the dividend we annex to new dividend two ciphers and place a decimal point in the quotient to the right of the nineteen. Then proceeding as before we get our trial divisor by doubling present quotient $19 \times 2 = 38$ and place to the left of the dividend 500. 38 is contained in 50 once; we therefore place a 1 in the quotient to the right of the decimal point and annex to the new divisor, multiplying as before and sub-

tracting, we proceed in an exactly similar manner until we have no remainder or until decimal begins to repeat itself or is extended sufficiently to answer our purpose.

Example (3): Find the square root of 15227.56.

$$\begin{array}{r} 152.2756(123.4 \\ 1 \\ 22 \overline{) .52} \\ \underline{44} \\ 243 \overline{) 827} \\ \underline{729} \\ 2464 \overline{) 9856} \\ \underline{9856} \\ \dots \end{array}$$

In a decimal quantity like the foregoing, the marking off differs from the previous examples. Instead of counting twos from right to left begin at the decimal point and count twos towards the left and towards the right. Note: when the first two figures to the right of the decimal is brought down we must place a decimal point in our quotient before extending it.

Briefly, the process of finding the square root of a whole number may for the guidance of the student be described as follows:

First mark off in twos commencing from the right. Then find the number whose square is next less than the figure or figures on the left of the number as the case may be, place this figure in the quotient and its square under the figure or figures already marked off on the left of the number, subtract and annex to the right the next two figures of the number; this then becomes a new dividend. To secure a new divisor, double the quotient by multiplying by 2 and place on the left of the dividend as a trial divisor; find how many times this is contained in the dividend, discarding the right hand figure, place this result in the quotient and also in the new divisor and multiply by same number, placing product under dividend and subtract as before; continue the operation for a new divisor. Bear in mind, however, you must always place two figures to the right of the new dividend.

It will occasionally occur as in our first two examples that the product of the trial divisor multiplied by the new divisor will exceed the dividend. In this case take the next lowest term and proceed as described.

TO FIND THE CUBE ROOT.

Example (1): Find the cube root of 1331.

$$\begin{array}{r} 1.331(11 \text{ Ans.} \\ 1 \\ 31 \overline{) 300} \overline{) 331} \\ \underline{31} \\ 331 \overline{) 331} \\ \underline{331} \\ \dots \end{array}$$

First mark off three figures from the right towards the left of the number, and we have 1 left. Now, 1 cubed equals one. Place the cube of 1 under the one of the number and subtract. There is no remainder. Bring down the next three figures as a new dividend. Next multiply the one placed in the quotient by 3, and place the product well to the left, as in the example. Next multiply this 3 by the quotient figure 1, and place the result, 3, to the right of where the 3 was placed and to the left of the dividend, and add two ciphers to it, as shown in the example.

This 300 is called the trial divisor. Now see how often it will go into the dividend 331, which we find to be once. Put 1 in the quotient to the right of the one already there, and place 1 also to the right of the number 3 at the extreme left of the example.

Now, multiply this number 31 by the figure last placed in the quotient, and place the result under the trial divisor 300 and add. This now gives us the correct divisor, which we multiply by the last figure placed in the quotient and place result under and subtract from the dividend. There being no remainder, our root is now complete, and we find $\sqrt[3]{1331} = 11$.

Example (2): Find the cube root of 80677568161.

Process:

123	4800	80,677,568,161(4321 Ans.
	<u>369</u>	64
	5169	16677
	<u>15507</u>	1170568
1292	554700	1114568
	<u>2584</u>	56000161
	557284	56000161
12961	55987200	56000161
	<u>12961</u>	56000161
	56000161	56000161

The process to the second figure of the answer is a reproduction of last example.

TO FIND THE THIRD FIGURE OF THE ANSWER.

Multiply the 43 in the quotient by 3, equals $43 \times 3 = 129$; put this well out to the left as before. In the middle column of figures you will see the figures 369 and 5169; add these together, and to their sum add the square of the last figure in the quotient—that is in the present case 3. Then

$$\begin{array}{r} 369 \\ 5169 \\ 3 \times 3 = 9 \\ \hline 5547 \end{array}$$

This number, with two ciphers added, is our new trial divisor 554700. It goes into the dividend 1170568 twice. Place 2 as the third figure of the quotient, and place 2 to the right of the number 129 on the left. Multiply 1292 by this number 2 and place the result, 2584, under the trial divisor and add. Result, 557284 is now the correct divisor. Multiply this number by 2 and place underneath dividend and subtract. Bring down the next three figures. We now have 56000161 as a new dividend.

TO FIND THE FOURTH FIGURE OF THE ANSWER.

Multiply the quotient 432 by 3— $432 \times 3 = 1296$, and place this number to the left. Again in the middle column we have the figures 2584 and 557284; add together and add the square of the last figure in the quotient.

$$\begin{array}{r} 2584 \\ 557284 \\ 2 \times 2 = 4 \\ \hline 559872 \end{array}$$

This number, with two ciphers annexed, 55987200, is our new trial divisor, and is contained in the dividend once. Add one to the quotient, also to the number on the left. Multiply and subtract as before. And since we have no remainder our root is now complete, and $\sqrt[3]{80677568161} = 4321$.

There is another method of extracting the cube root which to the student may be simpler and process clearer, since it has the advantage over method just described that when the student has mastered the process of working out the first figure of the quotient he has the rest at his command, as the process is but a repetition, and is the same for four figures as for two.

Find the cube of 1728.

1	1,728(12
	728
$3 \times 10^2 = 300$	
$3 \times 10 \times 2 = 60$	
$2^2 = 4$	
<u>364</u>	728

First we mark off the number into quantities of three figures as in previous examples, and selecting the next lowest cube for the first figure of our quotient in the case 1, which is put down in the quotient and as a divisor. The cube of 1 is placed under the dividend and subtracted and next period 728 brought down as a new dividend. Now take the number in the quotient and add a cipher to it, making it 10, square this and multiply by constant 3; we then get $3 \times (10^2) = 300$ which is our trial divisor; for the next line multiply 10 by the constant 3 and multiply the product 30 by the figure placed in the quotient from the trial divisor $30 \times 2 = 60$; place this 60 below the 300 already obtained and add, to the sum of these numbers add the square of the last figure of the quotient, thus, $300 + 60 + 2^2 = 364$. This is now our correct divisor. Multiply by the last figure of the quotient, place underneath the dividend and subtract; being no remainder our root is complete.

APPLICATION OF FORMER STUDIES TO MECHANICAL AND ELECTRICAL ENGINEERING.

Since both numerical and algebraical formula will now be constantly used, it is absolutely necessary that students should endeavor to obtain facility in reading and solving formula generally.

The following signs must therefore receive particular attention, and be committed to memory.

+ is read plus, and means that the number following it is to be added to the number before it; thus, $4 + 3$ is 7.

- is read minus, and means that the number after it is to be subtracted from the number before it; thus, $5 - 2$ is 3.

$\times$ is read multiplied by, and means that the number before it is to be multiplied by the number following it; thus, 3×3 are 9.

$\div$ is read divided by, and means that the number before it is to be divided by the number following it; thus, $6 \div 3 = 2$.

= is read equal to, and means that the quantity after it is of same value as quantity before it; thus, $7 \times 3 = 21$.

9^2 is read as 9 squared, and means that the number is to be multiplied by itself; thus, $9^2 = 9 \times 9 = 81$.

9^3 means same number cubed; thus, $9 \times 9 \times 9 = 729$.

$\sim$ is read the difference between any two numbers, and means the less number is to be subtracted from the greater.

() are called brackets, and mean that all the quantities within them are to be put together first; thus, $5(4 - 2 + 3 \times 9)$ means that 2 must be subtracted from 4=2, and $3 \times 9 = 27 + 2 = 29$, and then this 29 is to be multiplied by 5= $29 \times 5 = 145$.

NOTE—When no sign is placed between a quantity and a bracket or a letter, it means that the quantity within the bracket is to be multiplied by the quantity outside. Thus in the foregoing the quantity within the bracket=29 is to be multiplied by 5, the quantity outside.

SIGNS THAT REPRESENT ROOTS OF NUMBERS.

The sign known as the radical sign is common to all numbers, and is expressed thus, $\sqrt{\quad}$ or $\sqrt{\quad}$. When it is required to express the square root of a number we simply put this sign before it, as $\sqrt{25}$, but if the number for which we desire the square root of is made up of two or more terms then we express the square root by the same sign in front, but with a line as far as the square root extends, as $\sqrt{15+10}=5$, or $\sqrt{5(2+3)}=5$.

The cube root is expressed in a similar manner, but with a small 3 in the elbow of the sign, as $\sqrt[3]{\quad}$; all other roots in exactly same manner; as $\sqrt[5]{\quad}$ and so on.

In mechanical text books the power and root are often combined and expressed thus $4^{\frac{3}{2}}$. This is read as the square root of 4 cubed. Therefore, the numerator represents the power and the denominator the root. In this case the square root of 4=2, and 2 cubed equals 8.

The commonest form in which this is met with in engineering calculations is when the cube root of a number is squared, as $27^{\frac{2}{3}}$ which is read cube root of 27 squared. The cube root of 27 is 3 and 3 squared equals 9, which is the value of $27^{\frac{2}{3}}$.

One of the most frequently occurring errors in algebraic calculations is the misunderstanding of the proper use of the multiplication sign in algebraic quantities and formula, and requires special mention here. For instance, we have the quantity $25 - 10 \times 2$. It is a common error to say $25 - 10 = 15$; this multiplied by 2 equals 30. This is entirely wrong, as a moment's reflection will prove to the student, as it clearly reads 25 minus 10×2 , and the first step should be to multiply $10 \times 2 = 20$; then, $25 - 20 = 5$, which is correct, and not 30, as at first appears.

The student requires to remember the following rule, which applies in all cases:

Multiplication and division signs CONNECT the numbers together between which they occur; plus and minus signs SEPARATE them.

For simplicity and accuracy, it is a good rule when working with complex formula, to first get rid of bracket signs, and then multiplication signs; the operation of computation of formula then becomes an easy task.

NOTE.—Next issue will contain formula and rules for spring and lever safety valves and electrical formula.

Mr. Wm. Cross, Chief Engineer of Waterworks, Calgary, writes: "I think the NEWS is getting better as it grows older."

The Dardanelles Mining Co., at Kaslo, have just placed an order with the Rossland branch of the Jenckes Machine Co., of Sherbrooke, for a complete mining plant for operating their extensive properties in that district.

SPARKS.

By a recent storm about fifty telephones were burned out at London, Ont.

La Compagnie Electrique de St. Etienne de Malbaie is applying for incorporation.

A dynamo is being installed at the C. P. R. shops, Perth, Ont., for incandescent lighting.

The Hamilton, Grimsby and Beamsville Railway are erecting a new station at Beamsville.

The Cornwall Electric Railway Company is considering the extension of the road to neighboring villages.

The Revelstoke Water, Light and Power Company will sell sufficient shares to put in an electric light and power plant.

The new electric railway at Quebec has been completed and put in successful operation. We hope to publish a description of same in an early issue.

The city of St. Hyacinthe, Que., has just closed a contract with the Jenckes Machine Co., of Sherbrooke, for two pressure filters with a capacity of 750,000 gallons in twenty-four hours.

The Kay Electric Company, of Hamilton, has been dissolved. Job & Lynch continue the business on James street north, and Thomas L. Kay has established the Canada Electric Motor Company on Bay street north.

The smoke from the Terauley street power house of the Toronto Electric Light Company is said to have had a bad effect upon the new municipal buildings, and the company have decided to put in smoke consuming appliances.

Mr. J. H. Still has made a proposition to the City Council of St. Thomas to electrify the street railway. The proposed electric road will be six and a quarter miles long, and will cost about \$80,000, exclusive of power house.

The Kootenay Electric Co., of Kaslo, B. C., who have a large water power near the town and purpose using the same for power and lighting, have placed their order with the Royal Electric Co. for a 75 k.w. S.K.C. generator and the necessary transformers and motors.

Word comes from Ottawa of the application for a Dominion charter by a company to manufacture calcium carbide. Its capitalization is \$11,000,000, and the Hon. A. G. Blair, Rufus Pope, M.P., and a number of Canadian and American capitalists are among the applicants.

Harry Smith, engineer at the Wortman & Ward Manufacturing Company's factory at London, Ont., was recently badly burned. He was engaged in throwing the refuse oil and varnish into the furnace, when the flames suddenly shot out into Mr. Smith's face, burning his hair and whiskers off.

Mr. A. J. Corriveau, of Montreal, succeeded in getting his railway bill through parliament before the close of the session. He now has the right to construct electric lines between Montreal,

St. Johns, St. Hyacinthe, Sherbrooke, Magog, Waterloo, and other points, and hopes to have the road completed within one year from the present time.

Mr. Pamphile Boivin, of the town of Baie St. Paul, Que., has received a franchise from the corporation of that town for electric lighting, and the Royal Electric Co. is now installing for him an electric lighting plant, consisting of a 500-light S. K. C. dynamo, with the necessary transformers and material. It is expected that the plant will be in operation about the 1st of September.

A decision has been rendered in the appeal case of the city of Montreal against the Standard Light and Power Company of that city. The Lachine Rapids Hydraulic and Land Company, which obtained a controlling interest in the Standard Company, made excavations preparatory to laying conduits in the city under the latter's act of incorporation. The city objected and sent a squad of police to prevent the men digging. A legal injunction was secured enjoining the city. The matter has been carried to the Privy Council, and the company succeeds.

MOONLIGHT SCHEDULE FOR AUGUST.

Day of Month.	Light.	Extinguish.	No. of Hours.
	H.M.	H.M.	H.M.
1.....	P. M. 8.00	A. M. 4.10	8.10
2.....	" 8.20	" 4.20	8.00
3.....	" 8.20	" 4.20	8.00
4.....	" 9.30	" 4.20	6.50
5.....	" 10.00	" 4.20	6.20
6.....	" 10.50	" 4.20	5.30
7.....	" 11.47	" 4.20	4.40
8.....	.....	" 4.20	3.50
9.....	A.M. 12.30	.....	2.20
10.....	" 2.00	" 4.20	.....
11.....	No light.	No light.	.....
12.....	No light.	No light.	.....
13.....	No light.	No light.	.....
14.....	No light.	No light.	.....
15.....	P. M. 7.30	P. M. 9.10	1.40
16.....	" 7.30	" 9.30	2.00
17.....	" 7.30	" 9.50	2.20
18.....	" 7.30	" 10.10	2.40
19.....	" 7.30	" 10.30	3.00
20.....	" 7.30	" 11.00	3.30
21.....	" 7.20	" 12 00	4.40
22.....	" 7.20	A. M. 1.00	5.40
23.....	" 7.20	" 2.10	6.50
24.....	" 7.20	" 3.10	7.50
25.....	" 7.10	" 4.20	9.10
26.....	" 7.10	" 4.30	9.20
27.....	" 7.10	" 4.30	9.20
28.....	" 7.10	" 4.30	9.20
29.....	" 7.10	" 4.30	9.20
30.....	" 7.20	" 4.40	9.20
31.....	" 7.30	" 4.40	9.10
Total,			158.50

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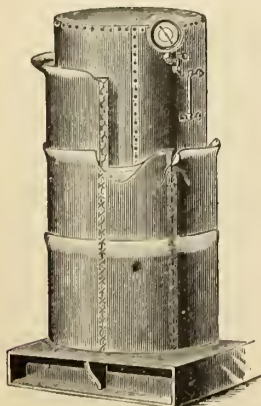
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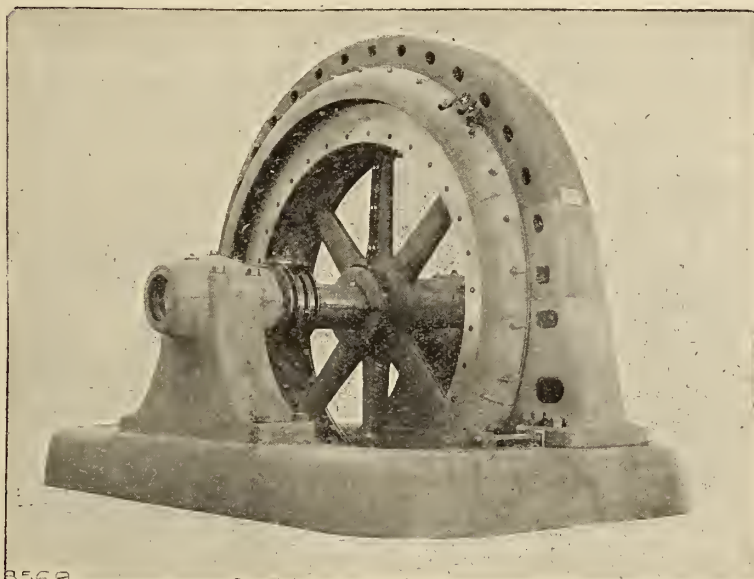
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have just commenced work on the most important power transmission plant so far undertaken in Canada outside of the immediate neighborhood of the city of Montreal. The distance of transmission is thirty miles, the line potential 20,000 volts, and the amount of power to be developed 8,000 horse power. For this important work the three-phase system of the Canadian General Electric Company has been selected and a contract awarded for the initial installation of 2,000 horse-power. The generators will be of the revolving field type, and of 1,000 h.p. capacity each. In type they will be generally similar to the twelve 1,000 h.p. units now being installed for the Lachine Rapids Hydraulic & Land Co.

SPARKS.

Mr. John B. Kelly, manager of the electric light plant, Blyth, Ont., says, "I would not be without the ELECTRICAL NEWS at any price."

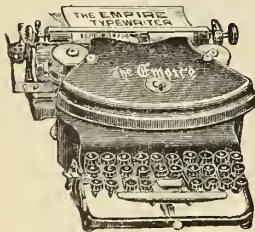
The Jenckes Machine Co. have installed at the new works of the Boston Rubber Co. at St. Jerome, one of their 55 in. Crocker turbines, with wheel case and 300 ft. of feeder pipe.

Mr. W. Stewart, who controls the electric light plant of Lucknow, is installing a new plant in place of the one destroyed by the burning of his mills last June. The new plant will consist of a Reliance dynamo and instruments from the works of the Stevens Manufacturing Co., London.

Dr. J. A. McLeay, of Watford, has purchased from the Royal Electric Co. a 500-light alternator and the necessary transformers, and is installing an incandescent plant in the town of Watford. He has about 300 lights wired up, and expects to have the light turned on August 4th.

La Compagnie Electrique, of Chicoutimi, Que., have increased the lighting capacity of their plant by the addition of another 40 k. w. S. K. C. generator, which they have purchased from the Royal Electric Co. This addition has been made necessary owing to the growth of their power transmission work.

Mr. Green, of the Wingham Electric Light Co., having procured the franchise for Brussels, has commenced the erection of a new power house, 40 x 50 feet, two stories, stone and brick, and will have the same in running order by October 1st. The Brussels plant will consist of a Goldie & McCullough high speed Ideal engine, with boiler, and two direct-current dynamos and instruments from Stevens Manufacturing Co., of London.



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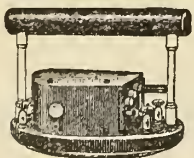
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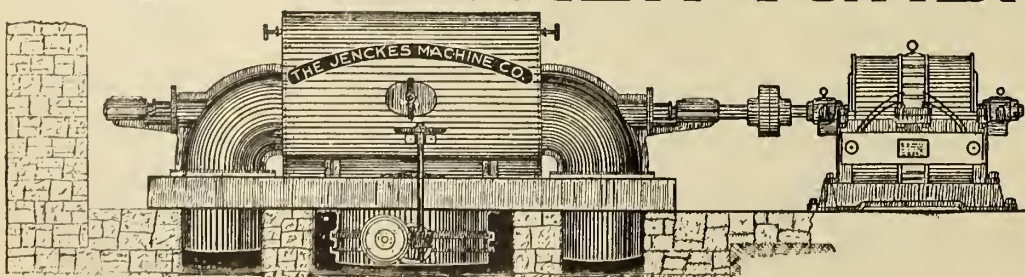
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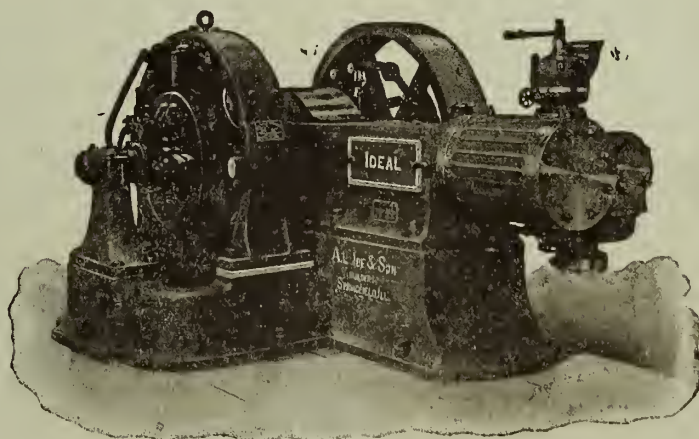
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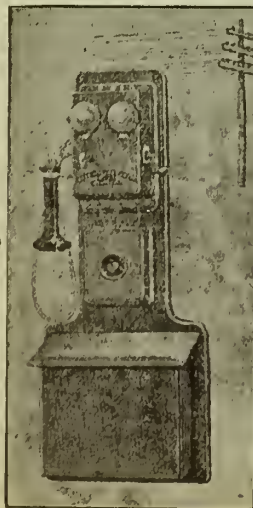
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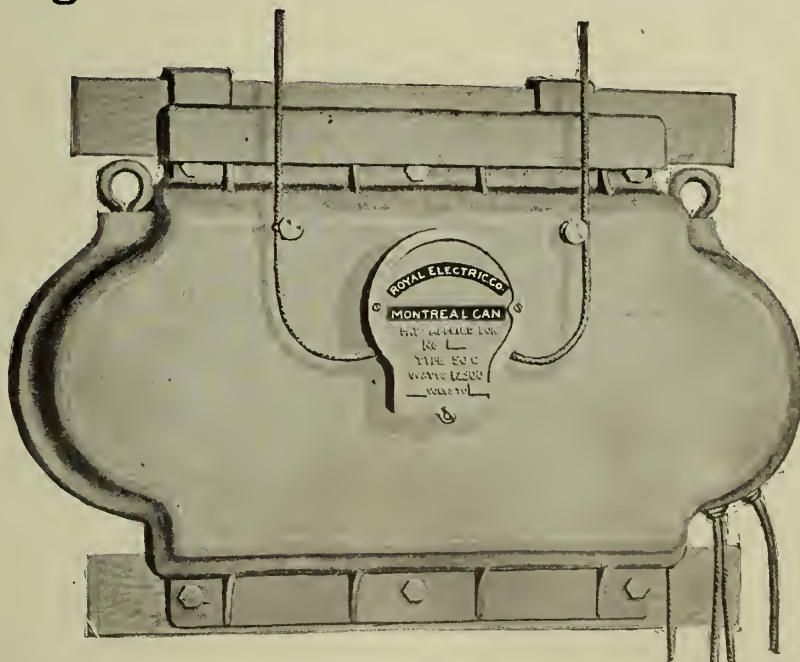
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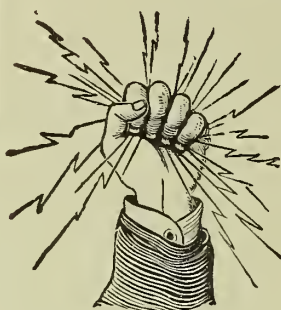
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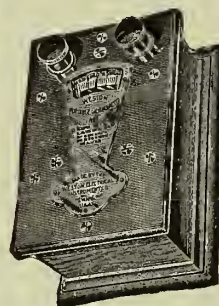
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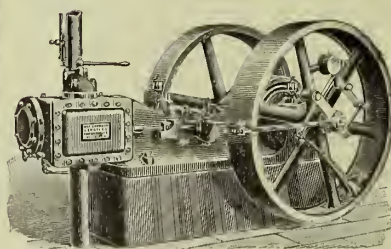
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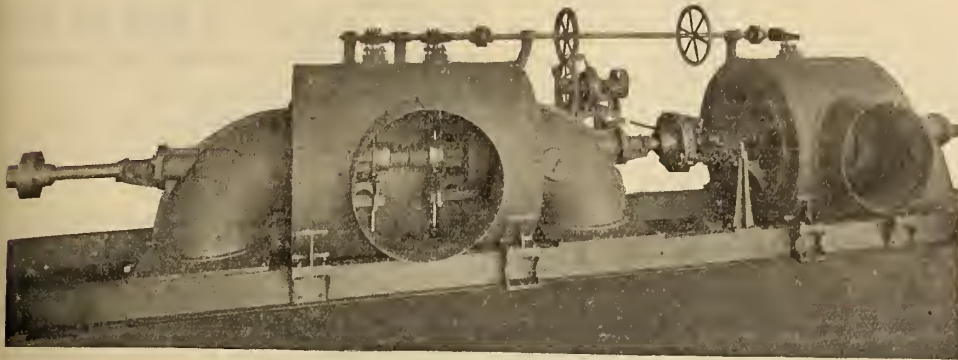
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This Engraving represents three 21 inch Turbines operating under 64' head, in the Plant of Chas T. Westcott, Baltimore, Md.

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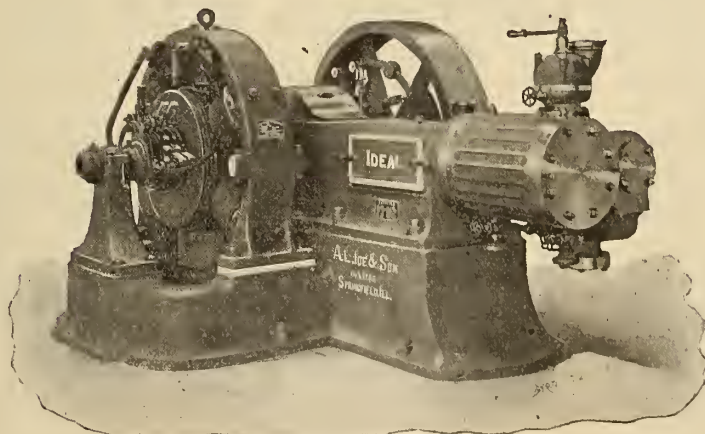
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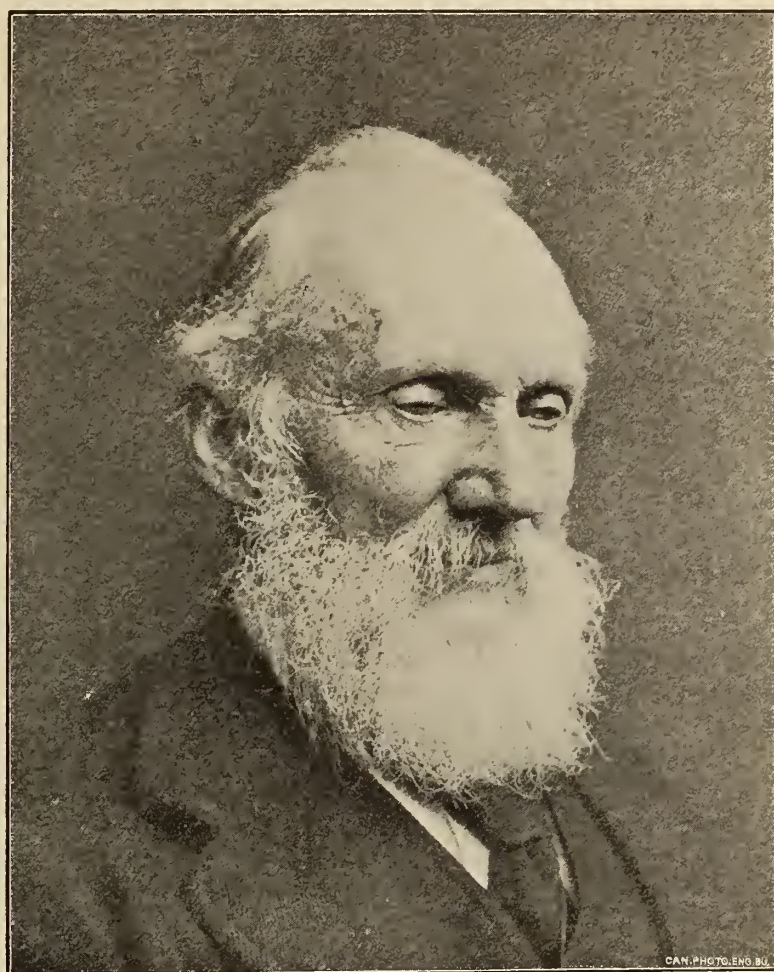
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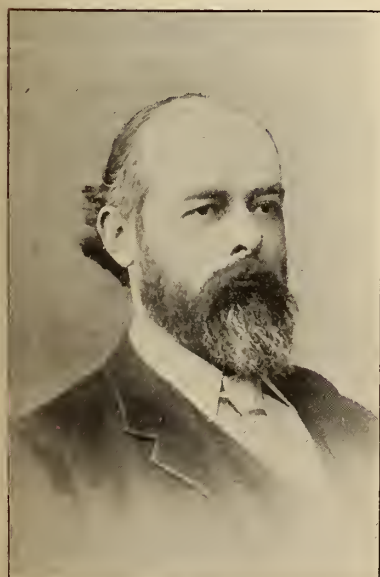
VOL. VII.

SEPTEMBER, 1897

No. 9.



LORD KELVIN, M.A., D.C.L., F.R.S.E., Past President of the British Association.



PROF. OLIVER J. LODGE, D.Sc., F.R.S.



PROF. W. E. AYRTON, F.R.S.



MR. W. H. PREECE, C.B., F.R.S.

GROUP OF BRITISH ELECTRICIANS

BRITISH ELECTRICIANS.

ON the previous page appear the portraits of several British electricians who were in attendance at the recent convention in Toronto of the British Association for the Advancement of Science. Lord Kelvin, long known as Sir William Thomson, is one of the most eminent scientists of to-day, and to him is due in no small degree the wonderful advancement which has been made in the development of electricity in recent years. He was born in Ireland in 1824, and graduated at several colleges. From 1846 to 1852 he was Fellow in St. Peters College, Cambridge, and since that time his life has been devoted to the progress of physical science. To telegraphy Lord Kelvin's services have been of peculiar value. He acted as electrician for the Atlantic cable, 1857-58 and 1865-66; he invented the mirror galvanometer and siphon recorder in connection with sub-marine telegraphy; he acted as electrical engineer for the French Atlantic cable, 1869; the Brazilian and River Plate, 1873; the West Indian cables, 1875, and the Mackay-Bennett Atlantic cables, 1879. He has invented a mariner's compass and navigational sounding machine, and many electrical measuring machines. His work has been of immense value in promoting commercial intercourse. The successful completion of the Atlantic cable in 1866 brought him knighthood, and in 1892 he was created a baron. Last year he celebrated his jubilee, which was a notable event in the world of science.

Professor Oliver J. Lodge was born in Staffordshire in 1851, and has been Professor of Physics in University College, Liverpool, since 1881. He has given considerable attention to electrical matters, and is the author of numerous publications, including "Elementary Mechanics," "Modern Views of Electricity," "Pioneers of Science," "The Work of Hertz and His Successors," and "Lightning and Lightning Guards."

Prof Ayrton is now in his fiftieth year. He is a Londoner, and entered the Indian Telegraph service in 1867, and afterwards pursued his studies under Lord Kelvin. When he went to India he became assistant to the Electrical Superintendent of the India Government Telegraph Department, returning on leave to England in 1872, and being employed on various matters relating to telegraphy, including the electrical testing of the Atlantic cable in 1873. On the establishment of the Japanese Imperial College of Engineering, he was offered the Professorships of Physics and Telegraphy, which he held until 1878. In 1884 Prof. Ayrton was appointed Professor of Applied Physics at the City and Guilds of London Central Institution. He is a joint editor of Messrs. Cassells' "Manuals of Technology," having written one of the series, "Practical Electricity," which has run through several editions. He gave a valuable lecture at Bath in 1888 entitled "The Electrical Transmission of Power."

Mr. W. H. Preece was born in Wales in 1834. He was appointed to the Electric and International Telegraph Co., 1853, becoming superintendent of the Southern Division in 1856. After attaining eminence in the telegraph world he was in 1870 transferred to the General Post-office as Divisional Engineer, in 1877 being appointed Engineer, and in 1892 Engineer-in-Chief, and is also Consulting Engineer to the Colonies. He has been associate author of text books on telegraphy and the telephone.

QUESTIONS AND ANSWERS.

Mr. "J. G." writes: I have been thinking of using my exhaust steam from lighting engine to heat our building, but do not know how to do it without putting on back pressure, which I wish to avoid. Our building is four stories high, and is piped on the two-pipe system, carrying steam at 15 lbs. I understand there is a system of exhaust steam heating, but the royalties charged are excessive, as far as I can make out. I would like to know if there is any other way, if not quite so elaborate as the patent way, may be. Details will be much appreciated.

Mr. James Johnstone asks: What would you advise me to do with my plant to bring down the temperature of my flue gases, as I find they are about 600° on entering the chimney, and this, I believe, is 200° too much. We use soft coal; common tubular boiler; fair draft; no forcing, and plant ample size; steam 85 lbs.

SIR,—I would like if some of your readers could advise me (1) what to do to keep the oil off a belt on the governor side of a high speed engine, and also what to do to extract the grease or oil from the belt. A handful or two of whitening I find to be a good thing to put on the belt when it slips badly, and will cure it for three or four hours. Sometimes I scrape it off (when running), but often I don't. (2) What advantage or disadvantage is there in raising or lowering the speed of a high speed engine? (3) When running a high speed automatic cut-off engine, which is the more economical pressure, at from 50 to 80 lbs.? Also, when running pumps and drying room coils and common 10 h.p. engine, I can carry anywhere from 40 to 80 lbs. Which is the best pressure, and why?

"ONTARIO."

"Subscriber" writes: I have a flue about 20 feet long from my two boilers to chimney, and would like to have the opinion of others as to whether I could, by placing water pipes on the outside on top, get a high enough temperature in the water to be worth the trouble and expense. We use about thirty feet an hour for each boiler. The flue is extremely hot—must be about 400° to 500°. Is it possible that it might help to destroy the draught by cooling the flue and lowering the temperature inside? It is not too good at present. I would like suggestions in detail. How can I figure out to see if a 12 x 9½" Armington & Sims' engine, running at 280 rev., 80 lbs. steam, will drive 250 amperes at 115 volts?

James McPherson asks: Would some of the boys tell me what is the best kind of oil to use in the hydraulic cylinder of an elevator? Ours has not had any for four years, but I think it should get some.

[Readers of the ELECTRICAL NEWS are requested to forward replies to any or all of the above questions before the 28th of September, in order that the answers may appear in our October issue.—THE EDITOR.]

TO OVERCOME THUMPING.

SIR,—For the benefit of brother engineers I thought I would tell them of how I got over the trouble of a thumping in the water end of my pump, and hope it may be of use to some one likewise situated. In the first place, it was getting water under a head of about 30 lbs., and pounded frightfully, but when pumping out of the tank she would run all right. However, as we could only use the tank occasionally, we had to suit her to circumstances. Air chambers I stuck on in abundance, on both sides of pump and on top of tank 70 feet high, where she pumped to; I also placed one 5 ft. x 8" on pump in place of small original one. I put on strong springs on suction valves and throttled the head of water, but all to no purpose—pound she would. At last I put on a little air valve on the suction pipe, and throttled the water until she had to draw her water the least little bit, and then very slightly opened the air valve, when all at once the trouble ceased and the pounding was no more.

A. ALEXIS.

It is understood that the Cornwall Electric Street Railway Company are making arrangements to extend their line to the Ottawa & New York railway station, 1½ miles distant.

The corporation of Magog, Que., are installing a 1,000 light single-phase alternator and other apparatus for their new incandescent lighting plant. The street lighting will be done by sixty 50 c. p. incandescent lamps, which are expected to furnish a much more satisfactory street lighting service than their equivalent of arc lamps. The apparatus is being furnished by the Canadian General Electric Company, of Toronto.

WESTERN ONTARIO LIGHTING PLANTS.

EXETER ELECTRIC LIGHT COMPANY.

The Exeter Electric Light Company was organized during the present year, through the efforts of Mr. R. C. C. Tremaine, who became manager. The plant, when completed, will consist of a G. E. 60 k. w. alternator and one 20 Royal arc machine, with usual switch board and instruments from the General Electric Company's works. The circuit is about $6\frac{1}{2}$ miles in length. A boiler, 66×14 , with eighty-four $3\frac{1}{2}$ inch tubes, and a Brown engine, 14×36 feet, furnishes the power. The power house is a two-story brick structure, 34×80 feet, with stone foundations and smoke stack of iron, 60 feet high.

When Mr. Tremaine assumed charge a few weeks ago there were about 350 incandescent lights in use. At the present time a staff of workmen are busily engaged wiring an additional 900 lights.

Mr. Tremaine is a native of Nova Scotia. He was born at Dartmouth, opposite Halifax, on November 4th, 1874. After passing through the public and high schools he, in 1891, entered the School of Practical Science at Toronto, graduating as B. A. Sc. in 1894, and taking a post graduate course in 1895. In the summer of the same year Mr. Tremaine took charge of the electric



MR. R. C. C. TREMAINE.

light plant at Long Branch, which position he filled for two seasons, when he removed to Exeter and formed the present company.

DURHAM ELECTRIC LIGHT PLANT.

Messrs. Kilmer, Crawford & McIntyre are the owners of the Durham plant, which was installed just one year ago. The power house, situated on the Rocky Saugeen river at Aberdeen, four miles from Durham, is a substantial frame building, 20×40 feet, with metallic sidings. Power is furnished by a Barber 90 h. p. water wheel. The generator is from the works of the Canadian General Electric Co., being a 75 k. w. monocyclic, the switch board and instruments being from same firm.

This company have about sixteen miles of wire and over 900 lights, and will shortly install a number of 50 c. p. street incandescent lights.

MOUNT FOREST ELECTRIC LIGHT PLANT.

The electric light was first introduced in Mount Forest in the year 1885, the present owners, Messrs. Corley & Collins, purchasing the plant from the former owners in 1890, and running only an arc system until 1893, when they installed an incandescent plant.

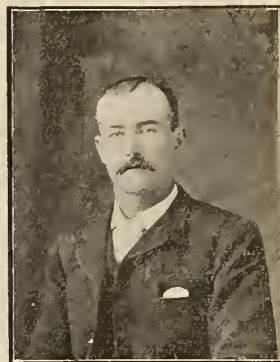
The power house is centrally located. Steam power is supplied by a Wheelock 140 h. p. engine and boiler, operating a 500 light National generator for incandescent system, 20 light Ball arc machine, 2000 c. p., with switchboard fitted with National instruments.

This company have 14 arc lamps and 350 incandescent lights installed, and are about to increase the number.

Mr. T. H. Collins acts as manager, and under his supervision an excellent service is being furnished.

CHESLEY ELECTRIC LIGHT PLANT.

This plant, owned by Mr. R. T. Bearman, is under the management of Mr. J. H. Fry. The power house is situated on the north branch of the Saugeen river, about $1\frac{1}{2}$ miles from the town. Power is supplied by two turbine water wheels of 100 and 50 h. p. There are over eight miles of wire, and there are installed 300 incandescent lights, 34 arc street lamps, and 25 50 c. p. street incandescent lamps. The generators are a 500 light Reliance and a 25 and 35 Reliance arc machines, with full complement of instruments.

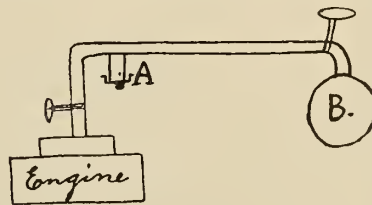


MR. J. H. FRY.

Mr. J. H. Fry, the electrician in charge, is a native Canadian, born near Port Hope, May 30th, 1864. He has been in charge of the present plant for over six years.

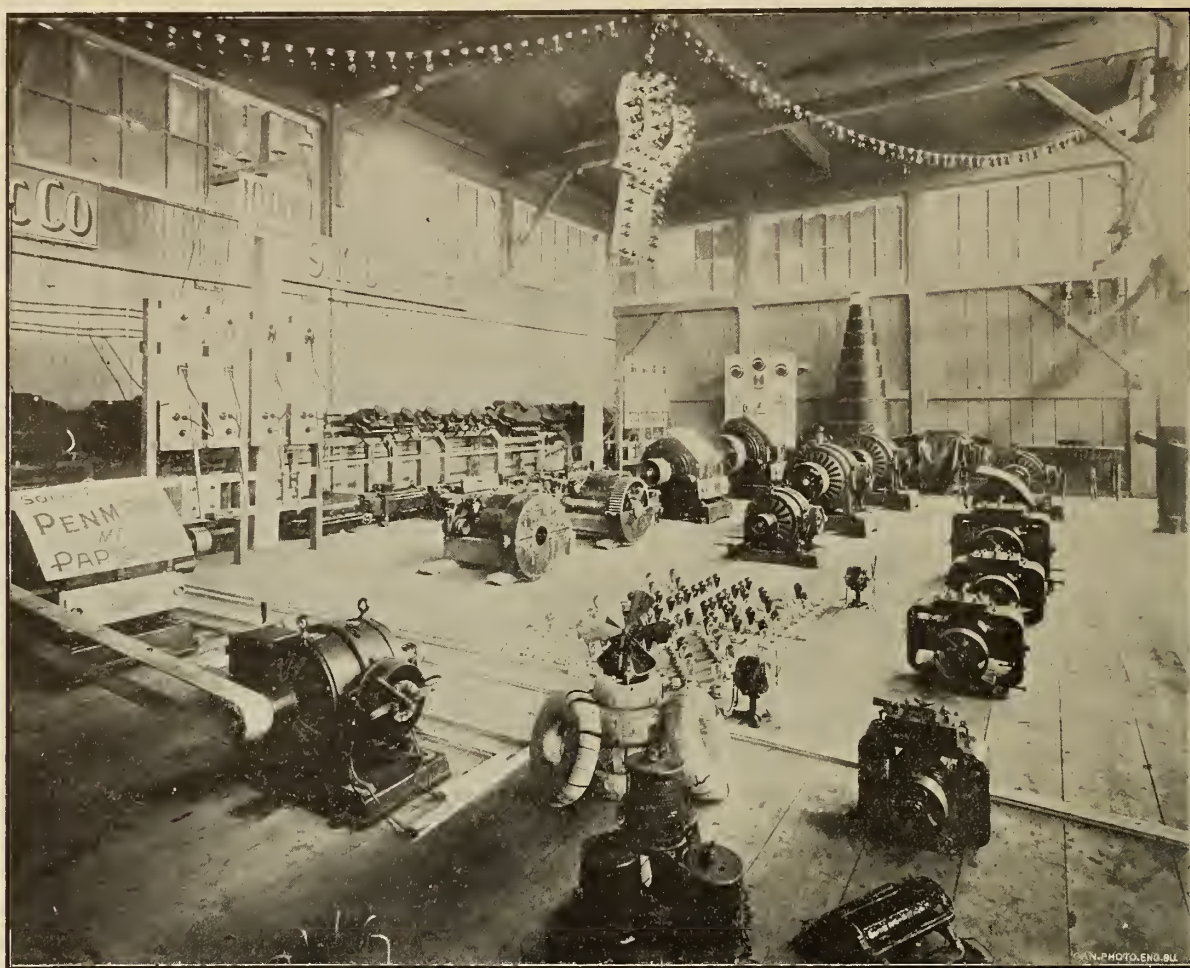
BOILER ACCIDENT AT LONDON.

LEONARD J. Grimshaw, a machinist employed by E. Leonard & Sons, of London, was killed in Watson's box factory recently. He was engaged putting in a new high speed Ball engine, and had started up steam before work on the engine was completed. The cap of the drip attached to the pipe used to conduct steam from the boiler to the engine blew out a short time after the engine was started. Deceased was standing right under the drip at the time, and was covered by the condensed steam. The force of the explosion sent him

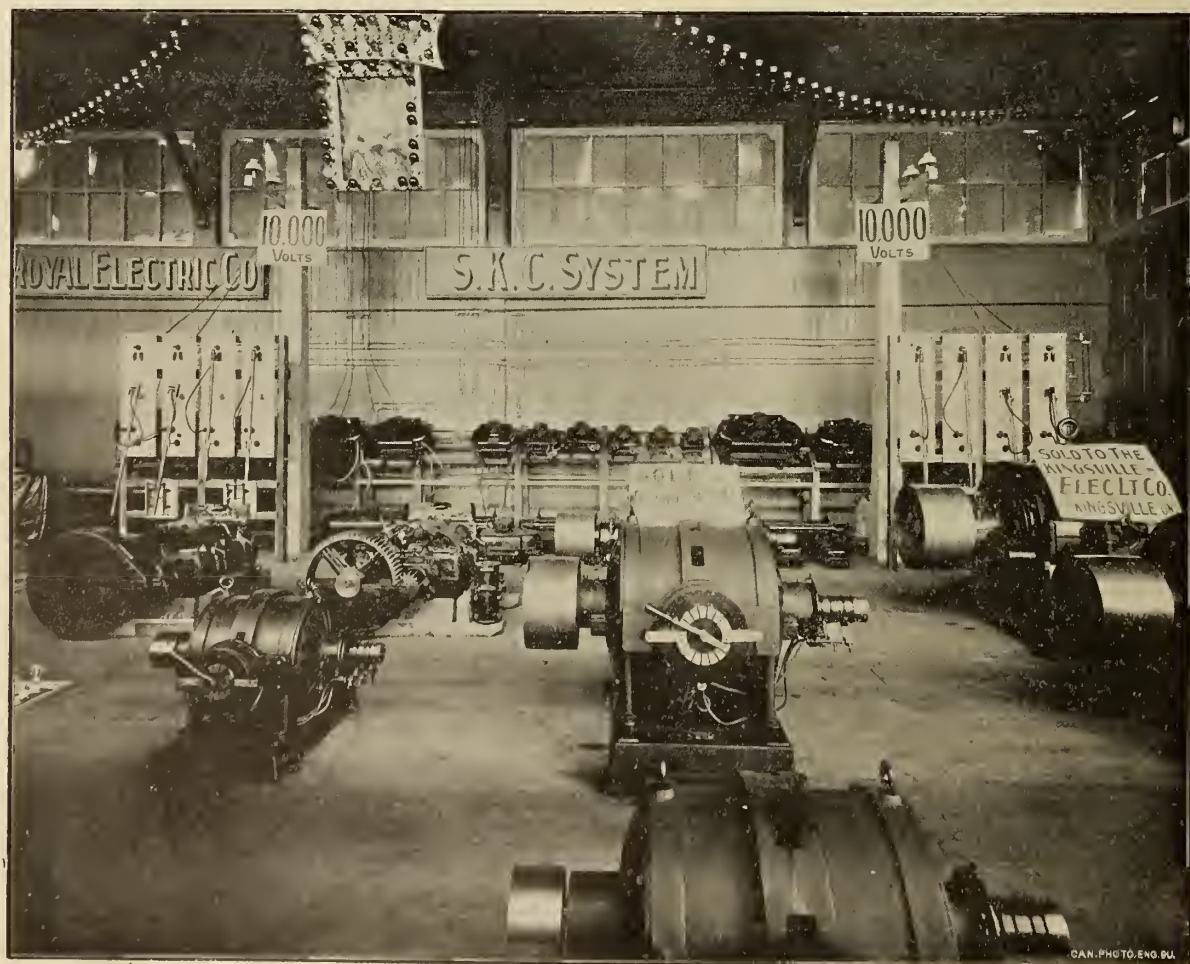


into a small hole about ten feet away. In the accompanying illustration, showing how the accident occurred, A is the drip pipe, with a cap (cast iron) at the end, tapped for $\frac{3}{4}$ or 1 inch pipe, and B the steam boiler. The pipe connections for drip had not been made at time of accident. The metal of the cap at bottom was $\frac{7}{16}$ inch, and the bottom blew clean out, but the thread never stripped. The steam pipe and drip were five inches in diameter.

The Doherty Organ Company, of Clinton, requiring an increased dynamo capacity, have placed an order with the Canadian General Electric Company for a 200 light incandescent machine of the Edison type.



GENERAL VIEW OF THE EXHIBIT OF THE ROYAL ELECTRIC COMPANY AT THE INDUSTRIAL EXHIBITION, TORONTO, SEPTEMBER, 1897.



VIEW OF THE EXHIBIT OF THE ROYAL ELECTRIC COMPANY AT THE INDUSTRIAL EXHIBITION, TORONTO, SHOWING THE HIGH VOLTAGE TRANSFORMERS AND SPECIAL SWITCH-BOARDS.

EXHIBIT OF ELECTRICAL APPARATUS.

ONE of the most interesting and unique exhibits at the Toronto Industrial Exhibition now in progress is that of electrical apparatus. There is a noticeable improvement in the display as compared with former years, although a number of the manufacturing companies are not represented. The growing interest in electrical apparatus is attracting many visitors to the east wing of Machinery Hall, where the exhibit is located. Each company has sufficient space to permit of the proper and most advantageous arrangement of the machinery, and the effect produced in the evening by means of the many colored lights is pleasing in the extreme.

The Royal Electric Company, of Montreal and Toronto, has practically two exhibits. Near the centre of the hall are located two Leonard engines of 60 and 100 h.p. The larger engine drives two Royal Electric Thomson-Houston 50-light arc dynamos, belted in tandem, these machines being used for lighting the machinery hall and other buildings. Belted to the 60 h.p. engine is an "S.K.C." two-phase generator, and set up near by is a switchboard complete. Behind the switchboard there are connected up two large transformers, which take up the full capacity of the machine. This generator furnishes the current for about 400 colored incandescent lights arranged over the company's exhibit in another part of the building. The above portion of the exhibit may be said to represent a thoroughly equipped central station, including arc and incandescent lights and motors complete.

Passing to the extreme east end of the building, we reach what may be termed exhibit No. 2. Here the 400 incandescent lights above referred to are arranged in festoons near the ceiling over the company's exhibit in such a manner as to give the most pleasing effect. In the centre is a crown of about 150 lights, while extending from the crown to the four corners of their space are rows of colored lights, numbering in all about 250. They have also on view twelve alternating current arc lamps, among them being some that burn 100 hours with one carboning.

On a large table is displayed a complete line of electrical supplies, while a pyramid of Royal sterling rubber covered wire is also to be seen. The machinery here exhibited includes a range of the well-known S.K.C. transformers, ranging from a miniature of 10 lights to one of 1200 lights capacity; a range of S.K.C. generators and motors, operating on the two-phase system, from 2 to 50 h.p., with switchboards; direct current four-pole dynamos and motors, and their latest type of street railway apparatus. A special feature of the exhibit is the high voltage transmission line, the current being generated at 2,000 volts and raised by means of step-up transformers to 20,000 volts, at which pressure it is conducted over high voltage insulators on the model pole line and again stepped down from 20,000 to 2,000 volts, and used in the regular S.K.C. transformers to illuminate the building. This portion of the exhibit is particularly interesting, inasmuch as the Royal Electric Co. are making a specialty of high potential work and long distance transmission, and this display is intended to illustrate a complete long distance transmission and distribution line.

By a specially constructed switchboard the danger to operators in transmitting under a pressure of 20,000 volts is entirely removed, as the switches are so arranged that there is no possibility of "arcing across" so frequently occurring in high voltage work.

In connection with the display of the Royal Electric Company, it may be noted that a type of every electrical machine made is exhibited. The principal feature noticeable is the tendency to do arc and incandescent lighting, as well as all kinds of power work, with alternating current, and judging from the various sizes of alternating and induction type motors shown, there appears no hesitancy about putting them on the market and guaranteeing results. Some conception of the magnitude of their exhibit may be obtained from the fact that four car loads of machinery were brought up from the factory in Montreal for the purpose, the work of erecting the same being done under the supervision of Mr. James Fleet, the company's expert.

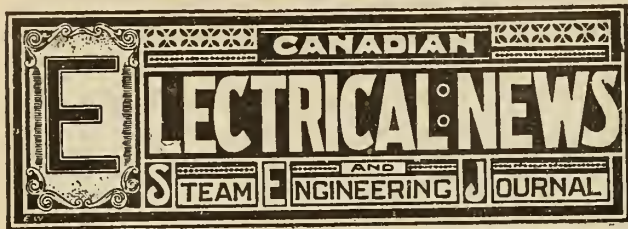
Entering the Machinery Hall from the south, we find on our right an attractive exhibit by the the W. A. Johnson Electric Company, of Toronto. An Ideal engine, manufactured by the Goldie & McCulloch Company, is driving two 110 volts direct current incandescent dynamos, operating on the three-wire system, furnishing current to incandescent and long burning arc lamps, and supplying incandescent lights for the main building and for operating the cinematographe. A 250-volt power generator drives several motors in different buildings. The exhibit of the company also includes the renowned Wagner transformers, enclosed long burning arc lamps, alternating and direct current ceiling fans, two arc light dynamos in operation for illuminating the main building, and their new 600 light inductor alternator. All the above apparatus are provided with full switchboard outfits, the whole having been manufactured at the Toronto factories of the company, and making a creditable exhibit.

The Kay Electric Manufacturing Company, of Hamilton, and the Jones & Moore Electric Company, of Toronto, each have well-arranged exhibits of dynamos, motors, lamps and general supplies. The former company has also on view a complete switchboard. The motors of the Jones & Moore Electric Company are painted white, presenting a neat appearance.

The special feature of the exhibit of the Toronto Electric Motor Company is their direct connected generators, which are claimed to be the first of the kind ever placed on exhibition in Canada, and from the number of persons who inspected the apparatus it was evident that the innovation was appreciated. A 30 k.w. dynamo is direct-connected to an Ideal engine of 60 h.p., running at 300 revolutions per minute. This generator, together with a complete switchboard, comprising a 600 light plant, was manufactured for the Methodist Book & Publishing Company, and will shortly be installed. There is also shown a smaller dynamo of 15 k.w., connected to a 20 h.p. Ideal engine, running at 550 revolutions and furnishing 110 volts. Motors from $\frac{1}{2}$ to 12 h.p. and arc lamps complete the exhibit. Arc and incandescent lighting and power are furnished from the same machine, and the economy in space by use of the direct-connected generators was freely commented upon.

The Shelby lamp is exhibited by the John Abell Engine Company, who have recently obtained the Canadian agency for these goods.

Owing to the convenient location of their large show rooms on Front street west, within one minute's walk of the Union Station, the Canadian General Electric Company made no exhibit at the Exposition. Many visitors to the city were shown through their immense warehouse, where everything in the line of electrical apparatus could be seen.



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Correspondence is invited upon all topics legitimately coming within the scope of this journal.

The "Canadian Electrical News" has been appointed the official paper of the Canadian Electrical Association.

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The Sarnia Tunnel.

THE Great Northwestern Telegraph Company have removed once for all the annoyance and expense occasioned

by the destructive action of acid upon their wires in the Sarnia tunnel, by enclosing them in a lead cable. Under the direction of Mr. A. B. Smith this new cable, encased in a wooden conduit, has been laid in a trench eighteen inches underground, alongside the railway tracks. The cable measures over 6,000 feet and weighs about 18 tons.

Steel Standards for Boilers.

ALL steel used for boilers of steamships constructed under Lloyd's rules is now required to have an ultimate tensile strength of not less than 26 tons, and not more than 30 tons per square inch of section, and the ultimate elongation must not be less than 20 per cent. in a length of 8 inches. It is to be capable of being bent to a curve, of which the inner radius is not greater than one and a half times the thickness of the plates or bars after having been heated uniformly to a low cherry-red, and quenched in water at 82° F.

Growth of Electric Lighting.

In the towns and villages of Ontario it is gratifying to observe the rapid growth of electric lighting, both for public and private use. New plants are constantly being installed in places where coal oil and gas has heretofore been the only illuminants, and frequent extensions to circuits are rendered necessary by the growing appreciation of electricity in places where this system of lighting has been employed. While the greatest advancement in this direction has been made in Ontario, it is by no means confined to this province. Throughout the entire Dominion the outlook for the electric lighting business is somewhat encouraging. In the maritime provinces many saw mills have recently been equipped with isolated plants, by means of which night

work is permitted, and it is thought that this branch of the industry will be considerably extended in the near future. These statements will, we believe, be borne out by the electrical manufacturing companies, who have enjoyed a comparatively good business during late years when commercial depression was almost general. True, the cost of electrical apparatus has been much reduced within a short period of time, leaving a smaller margin of profit to the manufacturer, but this has in a measure been offset by the greater volume of trade. A still wider adoption of electricity for lighting purposes will be witnessed before the close of the nineteenth century.

Electric Motor-Cabs.

WHILE in European countries gas and steam-motor propelled vehicles for road purposes have attained the greatest degree of success, experiments made in America would seem to be in favor of electricity as the motive power. The Electric Carriage and Wagon Company have inaugurated in New York city an electric-motor cab and carriage service, which is said to be meeting with much success, the power being furnished by storage batteries. Results show that about 1.25 horse power is necessary for the propulsion of 2,000 pounds over ordinarily approximately level roads at ten miles per hour. During the month of June 1,580 passengers were carried by these cabs a distance of 4,603 miles. The rates charged are one dollar for the first two miles or any part thereof, and 50 cents for each extra mile. It would appear that the field for the electric carriage was gradually widening.

The Progress of Science.

No better illustration could be found of the rapid strides which have been made of late years in the field of science than is afforded by a perusal of the proceedings of the British Association for the Advancement of Science, which for the first time in its history convened in Toronto in August last. To the city it was a source of congratulation that men who are so prominently identified with the progress of Great Britain should have assembled in Toronto in such large numbers. It is said that general surprise was expressed at the beauty of the Canadian cities visited, as well as at the abundance of natural resources possessed by the Dominion of Canada. As these impressions are made known throughout the countries of Europe, benefits to Canada are likely to follow. It was pleasing to observe that of the various branches of physical and natural science, that of electricity received perhaps greater attention than any other. There were present at the meeting a number of well-known electricians, who took an active interest in the proceedings. A paper of more than ordinary value was read by Prof. Ayrton, entitled "Some Tests on the Variation of the Constants of Electricity Meters with Temperature and Current," the author being Mr. G. W. Donald Ricks. The discussion following showed that an opinion existed that electric meters register more accurately than gas meters, but that there is still much room for improvement in them. There is a growing demand for a meter that will work accurately and can be purchased below the present cost. Some other papers of electrical interest were: "On a Method of Determining the Specific Heat of a Liquid in Terms of the International Electric Units," by Prof. H. L. Chandler and H. T. Barnes; "On the Fuel Supply and Air Supply of the World," by Lord Kelvin; "On the

Constitution of the Electric Spark," by Arthur Schuster; "An Electric Curve Tracer," by Prof. G. B. Rosa; "On the Source of Luminosity in the Electric Arc," by Henry Lerew and Mr. Basquin; "The Sensibility of Galvanometers," by Prof. Ayrton and Prof. J. V. Jones; "On Some New Forms of Gas Batteries and a New Carbon Consuming Battery," by Willard E. Case. A paper by Mr. G. C. Cunningham, late manager of the Montreal street railway, was also read.

An Immense Water Power Scheme.

STEPS have been taken by the St. Lawrence Construction Company, composed largely of British capitalists, to carry out an immense electrical water power development scheme at Messina, N. Y. Near this point the St. Lawrence river runs through a series of rapids, and in the course of seven miles there is a fall of 56 feet. About three miles from these rapids there runs the Grass river, some 300 feet wide, which takes its course through a gorge nearly 50 feet deep. It is proposed to cut a canal through the level plateau and to establish a power house on the banks of the smaller river. The water would be delivered upon turbine wheels with an absolute head of over 40 feet, and after actuating the turbines, would flow through the valley of the Grass river and re-enter the St. Lawrence below the rapids. The canal is intended to develop 150,000 horse-power, of which one-half will be rendered available in the first instance. Contracts for the entire work have been let, and the company hope to have the undertaking completed by December, 1898. The electrical apparatus, including fifteen 5,000 h. p. generators, are being manufactured by the Westinghouse Electric and Manufacturing Company, of Pittsburg. Each generator will weigh about 350,000 lbs., and will stand 22 feet high above the top of foundations. It is estimated that the entire plant and canal will cost in the neighborhood of two million dollars, and that power can be sold at fifteen dollars per horse power per year, running twenty-four hours.

OUTLOOK FOR MECHANICAL ENGINEERS.

W. S. G. writes: May I ask as a favor your opinion as to what the prospects are for those graduating in Electrical and Mechanical Engineering at the School of Practical Science, Toronto? I have seen in your paper opinions both optimistic and pessimistic. Those opinions apply, however, to those graduating as Electrical Engineers. Has not the graduate in the above course also open to him the field in Mechanical Engineering, including draughting, designing, inventing, etc.? I am contemplating taking the above course, but feel that my knowledge of what the profession is, what it includes and what the prospects in it are, is not definite enough. I have always had a liking for applied science and machinery, and have confidence of success along this line. Prof. Galbraith says, "Success depends on the special fitness of the candidate for his chosen vocation." I am at present at home on my father's farm, but, as I said, am contemplating taking this course, and would appreciate very much your opinion and advice.

ANSWER.—It is a difficult matter to advise you as to the course you should pursue in the absence of knowledge of all the circumstances of the case. Speaking in general terms, however, we would say that the engineering colleges appear to be turning out a larger number of graduates than the employment in this line would seem to warrant, and there are many competent engineers, civil, mechanical and electrical, who are unable to find employment at salaries commensurate with their abilities and the expense connected with their education. In view of these facts, you should give the subject careful enquiry and consideration before deciding to enter the field, as it seems to us it is only those who are favorably circumstanced, as to means, education and natural fitness, who can reasonably expect to achieve any large measure of success. Our opinion is that too many young men are forsaking good homes on the farm to enter commercial and professional lines. We believe that a young man who understands farming in a scientific manner and has some means at his disposal with which to make a start, is more likely to secure a comfortable living and a fair competency than the one who comes to the city and takes a professional course.

NEW BUILDING AND EQUIPMENT OF THE BELL TELEPHONE COMPANY, MONTREAL.

THIS company's new building, at the corner of Notre Dame and St. John streets, Montreal, contains the head office, eastern and local department offices, electrical engineering department, main exchange, distributing room, power room, and various other departments, including the Montreal agency. The Merchants Bank of Halifax occupies a large portion of the ground floor; the Royal Victoria Insurance Company and the Northern Electric & Manufacturing Co., Limited, have offices on the first floor; and the first and third floors are laid out principally for offices to be rented. A corridor ten by one hundred and thirty feet (10' x 130') long runs from Notre Dame street to Hospital street, with a large vestibule at each entrance. Off this corridor are the entrances to the elevators, stairways, Montreal agency, long distance booths and the banking room. The bank is large, commodious, handsome and well arranged, the room being thirty-six ft. wide by one hundred and twenty-two feet long.

The vault in the bank was built by Messrs. J. & J. Taylor, Toronto, and is one of the most expensive and strongest safety deposit vaults ever built in Canada. The door of the vault, including the bolt work, is over a foot thick, made of chrome steel, according to the most modern practice in safe construction, and the walls, floor and ceiling are all of strength and thickness proportionate to the door. In connection with the vault are examining boxes for depositors and a book vault. There is also a directors' room, lunch and coat rooms, and a lavatory.

THE BELL TELEPHONE COMPANY'S OFFICES.

The whole of the second floor is divided into offices for the company, which also occupies a portion of the third floor. The board room on the second floor is 18' by 28'. This room, together with the president's office, occupies the Notre Dame street frontage on this floor. The other offices on this floor are the general office and those of the secretary-treasurer, stenographer, general superintendent and special agents. There are also book vaults.

On the third floor are located the engineering department, drafting office and testing department, power room, photographic dark room and long distance test

room. The operating room, which is 36 feet wide by 110 feet long, and 18 feet high, is on the fourth floor. It is lighted with large windows on all sides, and has a large prismatic skylight in the roof.

In order to protect the telephone apparatus in this room from fire, which would mean an enormous loss to both the company and the business community, it was necessary to construct the most fire-proof building possible. The floors, roof and walls are all made of incombustible material, and every window on the floor is provided with rolling steel shutters. The skylight over the operating room is of double thickness, and nothing has been omitted to guard and protect the whole from fire.

Off the operating room is the operators' lunch and reading rooms, a locker room, a lavatory, a steam clothes dryer and bath room. The rest of the floor is taken up by the janitor's quarters.

In the basement the underground wires enter the building at three points. They are assembled in the

distributing room, and from thence pass to the operating room in a fire-proof shaft. In the basement also are located the linemen's room, store room, engine room and boiler room.

The heating apparatus of the building consists of two Babcock and Wilcox boilers of the latest pattern; two immense Sturtevant steel fans

and independent vertical engines; a large steam coil, which draws the fresh cold air from an open court, heats it and forces it under pressure to every room in the building, and the vitiated air is exhausted through the corridors and elevator shaft, through roof ventilators and back to the outside entrance. The air, before delivery, is filtered, washed and dried, and is changed throughout the entire building once every eight minutes. The building is completely lighted by both gas and electricity, all the electric light wires being run in armoured conduits. There are two hydro-steam elevators.

The exterior walls are of brick and terra cotta, these being the best fire-resisting materials known for the purpose. The ground floor is of red terra cotta, the rest of the building being of buff brick and terra cotta.

With regard to the electrical features, commencing at the basement—the subscribers' lines enter the building in cables of two hundred wires each, all cables entering underground. The cables are hermetically sealed into



BELL TELEPHONE CO.—HEAD OFFICE AND MAIN EXCHANGE, MONTREAL.

iron terminals, or cable-heads, and the various pairs of wires are led to binding posts mounted on the sides of the cable-heads, but insulated from it. The cable-heads are secured to an iron-supporting framework of ingenious design, ample provision having been made for future increase. Close to this framework is the "main distributing frame," which is also an open iron framework, somewhat resembling the cable-supporting apparatus. To one side of this frame are connected the underground cable-heads by means of small cables de-

somewhat more complicated, consisting of a small coil of German silver wire, wound on a hollow brass spool, a short metal rod passing through the hole in the spool, being held in place by a drop of fusible alloy, the whole mounted in a rubber case. This contrivance is held between two springs. When a current greater than the apparatus will stand, commences to flow in the circuit, the spool heats, melting the fuse metal and releasing the pin, and this allows the line to ground, cutting off the heavy current from the office.



BELL TELEPHONE CO.—GENERAL VIEW OF OPERATING ROOM SHOWING LOCAL AND LONG-DISTANCE SWITCHBOARDS.



BELL TELEPHONE CO.—VIEW OF LOCAL SWITCHBOARD.

signed for indoor work, while to the other side is connected the cables leading to the switch room. On the side of the rack to which are connected the outside cables are mounted the lightning arrestors and "sneak" current protectors, the combination being well-known, technically, as style Number Four. The lightning arrestor consists of two plates of carbon separated by a ring of mica; lightning or other high potential currents will jump the air gap to ground without passing through the switch proper. The sneak current protector is

The two sides of the main frame are connected by separate pairs of "jumper" wires, a special "flame-proof" insulation being used. At this frame are made all changes due to new work, removal of instruments, changes in location of instruments, and, in fact, all causes.

OPERATING ROOM.

Leaving the main frame the lines pass, in cables, upstairs to the fourth floor, where the switch room is situated. Here the cables are connected to the inter-

mediate distributing frame, which is very similar to the frame down-stairs. This frame is used as a connecting point between cables from the main frame and cables to the switch board. Changes can be made here in order to rearrange the lines coming to any operator, for the purpose of equalizing the calls she will have to answer. For instance, if at a certain season of the year a particular line is used much oftener than usual, this line can be taken from the regular operator and put on another operator, who has fewer calls to answer, thus balancing the work.

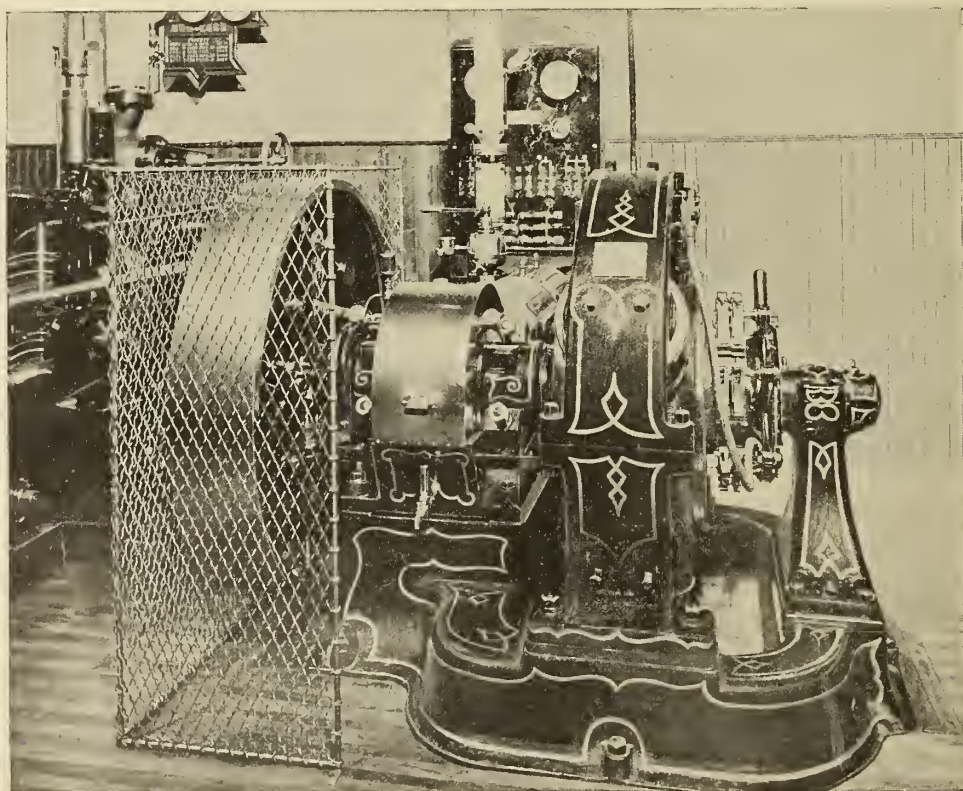
The switch-board proper is of the "branch terminal multiple" type, wired for 3,600 lines and having an ultimate capacity of 4,800 lines. At present 2,500 lines are working in this office. The number of lines an operator can attend to depends on the number of calls per line. In addition to the local positions there are several operators who receive calls from the branch offices and the long distance switch. All switchboard circuits are metallic throughout the switch.

A noticeable feature of the switch is the use of miniature incandescent lamps as signals. There is one in front of each operator, which glows as long as a drop

motor generators are used for ringing subscribers' bells. An elaborate switchboard is used for controlling these various power circuits. The very best material and workmanship has been employed from start to finish, and the board is thoroughly complete and up-to-date, comparing favorably with any exchange in the world.

A COMPLETE ISOLATED PLANT.

THE Canadian General Electric Company have recently installed for the O'Keefe Brewery Company, Limited, of Toronto, what is probably the completest isolated plant installed up to the present in any manufacturing establishment in the Dominion. The generator consists of a 25 kilowatt steel frame machine, direct-connected to an Ideal engine, running at 305 revolutions per minute. The design and construction of the apparatus are such as to secure the highest possible efficiency, combined with the greatest durability in service. The frame and pole pieces are cast from a specially selected soft steel of the highest magnetic permeability. The construction of the armature is such that currents of air circulate constantly through the core windings and commutator, ventilating them perfectly. The armature windings are



THE O'KEEFE BREWERY COMPANY'S PLANT.

is down in front of her, requiring attention. The lamp not only serves to attract the attention of the answering operator, but also the supervising operator. The chief operator has also a bank of lamps in front of her on her desk, which are connected to the lamps in front of the operators, by means of which lamps the chief can see at a glance how promptly calls are being answered. Lamps are also used to show when inter-office trunk lines are out of use, a new and most desirable feature. The long distance lines come to a separate switch at one end of the room, and are attended to by special operators.

The board has an iron frame, with a covering of polished cherry, and everything about it, with the exception of the wires and cables, was made by the Northern Electric and Manufacturing Company, in Montreal. The board was set up by the Telephone Company's employees, the work of erection taking about eight months, while the actual time of transferring the 2,500 lines, the trunk lines and long-distance lines, was one hour and five minutes. This was successfully accomplished on August 14th.

Power for the self-restoring drops, transmitters, lamps, signals, etc., is obtained from 16 cells of storage batteries, for the charging of which two horse power motor generators are used. Two half horse power

straight copper bars, requiring but two joints for each convolution, rendering short circuits and similar troubles practically impossible, and facilitating any repairs which might become necessary on account of mechanical injury.

The insulation of all the machines of this type is of the best, combining great mechanical strength and durability with high spark-resisting qualities. The increase in temperature up to full load is kept exceedingly low, and the use of carbon brushes insures absolute freedom from sparking under all conditions of load. Since starting up, this unit has shown itself to be entirely satisfactory, requiring practically no attention whatever.

The switchboard consists of a handsome dark marble panel, upon which are mounted the necessary switches and Weston instruments. A triple pole, double throw switch is used to connect the installation with the three-wire mains of the Toronto Electric Light Company, at such times as it is not desired to keep the plant in operation. The installation is one which reflects the highest credit upon the manufacturers, as well as being a source of satisfaction to the O'Keefe Company.

It might be added, that besides the lighting of the brewery, current is furnished to operate several small motors from which fans, ventilators, etc., are run throughout the buildings.

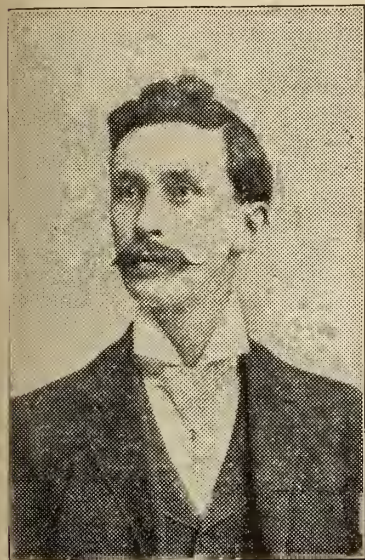
CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

EIGHTH ANNUAL CONVENTION.

BROCKVILLE was honored this year as the meeting place of the eighth annual convention of the Canadian Association of Stationary Engineers. The date, as fixed by the local association, was the 19th and 20th of August.

When the meeting was called to order at 9.30 a.m. of Thursday, there were in attendance the following executive officers:

James Devlin, Kingston, president; E. J. Phillip, Toronto, vice-president; W. F. Chapman, Brockville, secretary; R. C. Pettigrew, Hamilton, treasurer; J. Murphy, Montreal, conductor; J. F. Cody, London, district deputy for Ontario; O. E. Granberg, Montreal, district deputy for Quebec. The officers of the Brockville association, nearly all of whom were present, are: A. Franklin, past-president; John Grundy, president; Charles



MR. E. J. PHILLIP, President.

Bertrand, 1st vice-president; F. B. Andrews, 2nd vice-president; W. Robinson, financial secretary; James Aikens, recording secretary; John McCaw, treasurer; Stanley Beaverstock, conductor; C. Mortimer, door-keeper; Earnest Carr, E. Devine and James McRitchie, trustees.

Delegates reported as follows:

Toronto No. 1—G. C. Mooring, James Huggett, Chas. Moseley, A. M. Wickens, W. G. Blackgrove, John Fox.

Montreal No. 1—Thos. Ryan, J. J. York, J. G. Robertson.

Hamilton No. 2—Robt. Pettigrew, Geo. Mackie.

Stratford No. 3—John Hoy.

Brantford No. 4—Thos. Pilgrim, A. Ames.

London No. 5—G. B. Risler, Wm. Gerry.

Ottawa No. 7—Thos. Wensley, T. G. Johnston.

Dresden No. 8—T. M. Steeper, Wm. Jameson.

Berlin No. 9—W. J. Rhodes, Jacob Heyd.

Kingston No. 10—C. Selby, F. Simmons.

Winnipeg No. 1—G. M. Hazlett, James Robertson.

Kincardine No. 12—Percy Walker, J. Ashton.

Warton No. 13—J. F. Cody, Ed. Dunham.

Peterboro' No. 14—Fred Donaldson, John Morency.

Brockville No. 15—F. P. Andrews, C. Wilkinson.

Carleton Place No. 16—Jos. McKay, W. J. Griffith.

Waterloo No. 17—Chas. Uttley, Fred A. Pflug.

Ald. F. G. McCrady, a member of the association, introduced Mayor Downey, who read an address of welcome. "When Watt made his immortal discovery of the steam engine," said the Mayor, "he little thought of the vast extent to which it would develop, or that the time would come when towns and cities would be dependent on the steam engine, not merely for the comforts, but also for the necessities of life, and at times

even for their very existence. If we look at any of our great factories, with hundreds of skilled operatives, guiding and directing machinery of many different kinds, which is driven by power derived from one central source, or at the waterworks or electric light system of a great city, we shall find the steam engine the source of all the power, controlled and regulated by a faithful and energetic man, on whose skill and integrity the successful operation of the whole elaborate system depended. It was important, therefore, that competent, trustworthy engineers be employed."

The president acknowledged the welcome extended to the engineers in a brief speech, and was followed by Aldermen McCrady, O'Brien, Wright and Buell, each extending the hand of friendship to the delegates. Mr. W. F. Chapman read an address of welcome from the local association, in which the advantages of the organization were pointed out.

PRESIDENT'S ADDRESS.

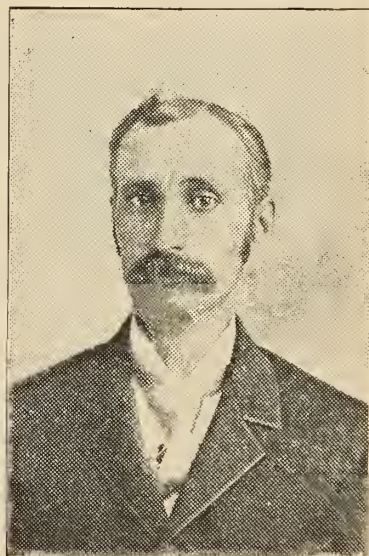
Mr. Devlin delivered the opening address as follows:

I have the honor to welcome you to this our eighth annual convention. I am aware that in selecting you as delegates our various branches have sent their best men, consequently I am confident that your deliberations will result in the advancement of our organization, and that in dealing with the various subjects brought before you, the one and only aim sought shall be the greater good of the C. A. S. E. I am sure that naught but good will shall prevail; indeed, such is one of the cardinal principles of our order. I need not ask for your hearty support, as this has always been given to the occupant of this chair.

The committee appointed to act jointly with the C. A. S. E. to draft a bill seeking from the Dominion Parliament a law compelling engineers to pass an examination and hold certificates of competency, met in Toronto on March 17th last. The result of the deliberations and a copy of the bill will be laid before you. As you are aware, the bill received two readings in the House of Commons, and I am assured by the delegates who had charge of the legislation at Ottawa that, were it not for the lateness of the session, there would have been every prospect of the bill becoming law. The thanks of the association are due to Mr. James Sutherland, M.P., for the kind reception of our delegates and for his earnestness in endeavoring to have the bill become law. In this connection I should say that in this movement not only are the members of our association a unit in favor of such a law, but, I might add, almost all the qualified engineers of this country are with us, as well as most of the manufacturers and steam-users.

During the past year some of our branches which had for some years shown want of vitality have been resuscitated. They are now possessed of fair membership, active and diligent in the work of the order, educational and social. London particularly is doing good work. On the whole our membership, however, shows a slight increase this year over last year. Guelph and Stratford, I am sorry to say, are not in a prosperous condition, and some effort must be made to infuse new life into these tardy branches. During the past year I can only report the establishment of one new association, that at Waterloo, Ont. It is to be hoped that during the coming year more advancement will be made in this regard. However, whilst our membership may not have materially increased in numbers, there has been great care exercised in the selection of members, and the principles of the order have been most rigidly adhered to. I am most pleased to know that in some of the lodges the work is done with great precision, the use of the book of ritual being dispensed with by many of the presiding officers. The educational work, the great feature of the organization, goes on with greatly increased vigor and benefit to the members.

During the year I had the pleasure of attending meetings at our two great centres, Montreal and Toronto. In both I was struck with the material progress visible and the facilities available to members by way of books, models, etc., whereby the educational benefits, so invaluable and important, are advanced. This feature of our association's work cannot be too highly appreciated. It may be necessary at the present convention to again take up the matter of bi-annual conventions, with a view to the curtailment of the expense necessary for our annual meeting. Steps should also be taken to arouse the engineers of the Dominion to the loss they sustain in not being of our membership. The provision made at last year's convention for the issuing of certificates of member-



MR. W. F. CHAPMAN, Vice-President.

ship has been carried out. The matter of getting up a handbook souvenir from which we expected to derive sufficient funds to meet the expenses of the convention has not taken practical shape, consequently, for this year at least, our old sources of revenue will have to be relied upon.

Our worthy secretary and myself have been in correspondence for some time past, and he will lay before you very important information on the subject, which will be of great value when the postponed work is again taken up.

Difficulties and persecution which I encountered in common with others in the same employ have rendered it impossible for me during the past seven or eight months to give the active work to the accomplishment of the souvenir scheme which I had wished. Brethren, in conclusion, I desire to express to you my deep sense of gratitude for the great honor you conferred on me a year ago when you elected me to the high and honorable position of president of this association and for the loyal manner you have stood by me. In closing, I will only add it is my heartfelt wish that your deliberations at this meeting may be so conducted towards each other that everything we shall do will redound to the benefit and honor of our good association.

The following were appointed auditors: J. Robertson, Montreal; F. Donaldson, Ottawa; Geo. Mackie, Hamilton; F. P. Anderson, Brockville.

Standing committees were appointed as follows: Credentials, J. Huggett, C. Selby, C. Uttley; constitution and by-laws, J. J. York, G. B. Risler, A. M. Wickens; mileage, Jas. Robinson, G. C. Mooring, F. M. Steeper; good of order, F. Simmons, C. Moseley, H. McKay.

Adjournment was then announced until 1.50 p.m.

AFTERNOON SESSION.

Upon resuming business reports on finance, constitution, and by-laws and credentials were presented.

"The Stationary Engineers' Act," presented to the Dominion parliament at the last session, came up for discussion. Although unsuccessful in securing the passing of the bill, it was stated to be the intention to again take up the question, and a committee for that purpose was named. At three o'clock the delegates were furnished with cabs and driven around the town. A visit of inspection was made to the Asylum for the Insane, the electric light station and the fire hall.

In the evening another session was held. Mr. A. M. Wickens gave a short talk on the C. A. S. E., and was followed by Mr. E. J. Phillip, who read an interesting paper on "Condensers, and Re-cooling Injection or Circulating Waters." A lively discussion followed the reading of the paper. Mr. G. B. Risler, of London, then read a paper on "The Steam Engine Indicator," which is unavoidably crowded out of this number.

The question of holding semi-annually meetings, referred to in the report on the Good of the Order, was discussed, with the result that the proposition was voted down. The reports of the secretary and treasurer were presented and adopted. The receipts for the year were shown to be \$431.25, and the disbursements \$164.26, leaving a balance of \$266.99. The question of publishing a souvenir was left in the hands of the secretary.

A contribution of \$10 from the Royal Oil Company, of Kingston, was acknowledged, and the secretary was voted \$25 for his services during the past year. At 10.30 adjournment was announced.

SECOND DAY.

The election of officers was the first business. The following was the result:

President—E. J. Phillip, Toronto.

Vice-president—W. F. Chapman, Brockville.

Secretary—J. C. Robertson, Montreal.

Treasurer—R. C. Pettigrew, Hamilton.

Conductor—G. B. Risler, London.

Doorkeeper—G. C. Mooring, Toronto.

Hamilton was decided upon as the next place of meeting.

Mayor Downey, on behalf of the association, presented the retiring president with a jewel. Mr. Devlin made a suitable reply.

Votes of thanks were tendered to the mayor and citizens of Brockville; to the retiring officers and the press.

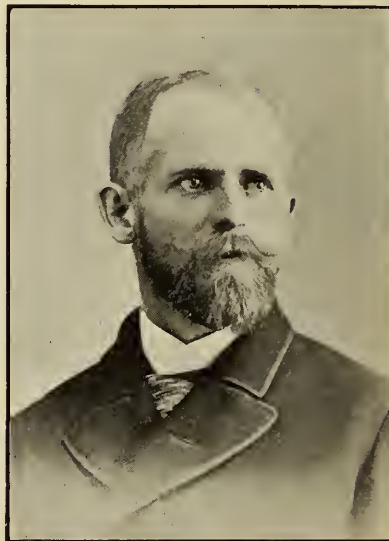
In the afternoon the delegates were given a trip up the river as far as Alexandria Bay, by the kindness of Mr. W. H. Comstock, who placed his steam yacht,

Albani, at their disposal. The outing was thoroughly enjoyed, an hour being spent at the bay. Upon returning at seven o'clock, a short closing session was held, at which the local association was tendered a vote of thanks for the arrangements made for entertaining the delegates. Special mention was made of Mr. R. A. Bush, chairman of the local committee.

THE BANQUET.

On Friday evening a banquet was tendered the visiting delegates by the local association at St. Lawrence Hall. Mr. Chapman presided, and besides a large number of engineers, there were also present prominent citizens, including ex-mayor Derbyshire, Town Clerk McMullen, and Mr. George Nicholson, of the James Smart Company. The menu was prepared to satisfy the most fastidious tastes, and was served in first-class style.

Following the usual attention given to the bill of fare came the toast list. The Queen was duly honored, and responses made to the various toasts by the persons named below: "Canada, our Home," by Rev. J. C. Sycamore, ex-Mayor Derbyshire and Town Clerk McMullen. "Brockville, The Island City," by Mayor Downey, Ald. McCrady and O'Brien. "The Manufacturers," by Messrs. Geo. Nicholson, of James Smart Mfg. Co., and T. G. Johnston, of Ottawa. "Kindred



MR. G. B. RISLER, Conductor.

Societies," by Messrs. F. Laurence, D. Reeves, W. J. Jento and A. M. Wickens. "The Executive," by Messrs. Devlin, Phillip, Pettigrew, Robertson, Risler and Mooring. The "C. A. S. E.," by Messrs. York, Blackgrove, Fitzsimmons, Andrews and Fox. "The Press," by representatives of the Times and Recorder and the Canadian Engineer. "The Local Association," by Mr. W. F. Chapman. "The Ladies," by Mr. Robertson, of Montreal, and "The Host and Hostess," by Mr. Horace Robinson.

Vocal music was furnished during the evening by Messrs. Blackgrove and Robertson, and recitations by Mr. Daly. Many of the delegates left for their homes on the midnight train, all pleased with the Brockville convention.

THE NEW OFFICERS.

Mr. E. J. Phillip, president-elect, is a gentleman of more than ordinary ability, and under his executive management the association may be expected to enjoy a year of marked advancement. He served his apprenticeship in Galt, removing to Toronto, where he was for two years engineer for the Toronto Incandescent Light Company. He is now chief engineer for the T. Eaton Company, having charge of one of the largest isolated plants in Canada.

In the first vice-president the association has an able officer. Mr. Chapman was born near Gananoque 37 years ago, has had considerable experience in setting up boilers and engines, and installed the electric light plant at Gananoque for the Electric Light and Water Supply Company. He now holds the position of en-

gineer for the Canada Carriage Company, Brockville. Through his efforts the local association was formed.

Treasurer Pettigrew, of Hamilton, is not an active engineer, although taking a deep interest in educational matters. His energies are devoted to the coal and wood business, in which he has been quite successful.

Mr. G. B. Risler, conductor, and the author of the paper on "The Steam Engine Indicator," stands as an example of self-education. He was born in Zurich, Switzerland, in 1858, and at the age of 14 years was depending on his own resources. Having a liking for machinery, he followed the employment of fireman for a number of years, gradually working his way into the engine room. In 1884 he emigrated to Canada and served as engineer in a saw mill and woolen mill. In the year 1891 he was engaged by the Advertiser Printing Company, of London, and since that time has made great strides in educational work. Mr. Risler joined the C.A.S.E. in 1893, and last year was chosen president. He has received great benefit from the association, and vice versa. Although not yet fully master of the English language, by the assistance of the Correspondence School of Scranton he has become well posted in engineering matters, and always endeavors to combine theory with practice. He has collected a most valuable library of engineering works.

THE NATIONAL ELECTRICAL CODE.

(Concluded.)

CLASS D.—FITTINGS, MATERIALS AND DETAILS OF CONSTRUCTION.

All Systems and Voltages.

40. WIRE INSULATION—

a. Rubber Covered—The insulating covering must be solid, at least three-sixty-fourths of an inch in thickness and covered with a substantial braid. It must not readily carry fire, must show an insulating resistance of one megohm per mile after two weeks' submersion in water at seventy degrees Fahrenheit and three days' submersion in lime water, and after three minutes' electrification with 550 volts. (See page 44.)

b. Weatherproof—The insulating covering must not support combustion, must resist abrasion, must be at least one-sixteenth of an inch in thickness, and thoroughly impregnated with a moisture repellent.

c. Flexible Cord—Must be made of two stranded conductors, each having a carrying capacity equivalent to not less than a No. 16 B. & S. wire, and each covered by an approved insulation, and protected by a slow-burning, tough-braid outer covering.

1. Insulation for pendants under this rule must be moisture and flame proof.

2. Insulation used for cords used for all other purposes, including portable lamps and motors, must be solid, at least one-thirty-second of an inch in thickness, and must show an insulation resistance between conductors, and between either conductor and the ground, of at least one megohm per mile after one week's submersion in water at seventy degrees Fahrenheit, and after three minutes' electrification, with 550 volts.

3. The flexible conductors for portable heating apparatus, such as irons, etc., must have an insulation that will not be injured by heat, such as asbestos, which must be protected from mechanical injury by an outer, substantial, braided covering, and so arranged that mechanical strain will not be borne by electrical connection.

d. Fixture Wire—Must have a solid insulation, with a slow-burning, tough, outer covering, the whole to be at least one-thirty-second of an inch in thickness, and show an insulation resistance between conductors, and between either conductor and the ground, of at least one megohm per mile, after one week's submersion in water at seventy degrees Fahrenheit, and after three minutes' electrification, with 550 volts.

e. Conduit Wire—Must comply with the following specifications:

1. For insulated metal conduits single wires and twin conductors must comply with section (a) of this rule.

Concentric wire must have a braided covering between the outer conductor and the insulation of the inner conductor, and, in addition, must comply with section (a) of this rule.

2. For non-insulated metal conduits single wires and twin conductors must comply with section (a) of this rule, and, in addition, have a second outer fibrous covering, at least one-thirty-second of an inch in thickness, and sufficiently tenacious to withstand the abrasion of being hauled through the metal conduit.

Concentric conductors must have a braided covering between the outer conductor and the insulation of the inner conductor, and comply with section (a) of this rule, and, in

addition, must have a second fibrous outer covering at least one-thirty-second of an inch in thickness, and sufficiently tenacious to withstand the abrasion of being hauled through the metal conduit.

41. INTERIOR CONDUITS—(For wiring rules, see Nos. 24 and 25.)

a. Each length of conduit, whether insulated or uninsulated, must have the maker's name or initials stamped in the metal, or attached thereto in a satisfactory manner, so that the inspectors can readily see the same.

Insulated Metal Conduits:

b. The metal covering, or pipe, must be at least equal in thickness, or of equal strength to resist penetration by nails, etc., as the ordinary commercial form of gas pipe of same size.

c. Must not be seriously affected externally by burning out a wire inside the tube when the iron pipe is connected to one side of the circuit.

d. Must have the insulating lining firmly secured to the pipe.

e. The insulating lining must not crack or break when a length of the conduit is uniformly bent at temperature of 212 degrees Fahrenheit to an angle of ninety degrees, with a curve having a radius of fifteen inches, for pipes of one inch and less, and fifteen times the diameter of pipe for larger pipes.

f. The insulating lining must not soften injuriously at a temperature below 212 degrees Fahrenheit, and must leave water in which it has been boiled practically neutral.

g. The insulating lining must be at least one-thirty-second of an inch in thickness, and the materials of which it is composed must be of such a nature as will not have a deteriorating effect on the insulation of the conductor, and be sufficiently tough and tenacious to withstand the abrasion test of drawing in and out of same long lengths of conductors.

h. The insulating lining must not be mechanically weak after three days' submersion in water, and, when removed from the pipe entire, must not absorb more than ten per cent. of its weight of water during 100 hours of submersion.

i. All elbows must be made for the purpose, and not bent from lengths of pipe. The radius of the curve in the inner edge of any elbow not to be less than three and one-half inches. Must have not more than the equivalent of four quarter bends from outlet to outlet, the bends at the outlets not being counted.

Uninsulated Metal Conduits:

j. Plain iron or steel pipes of equal thickness, or of equal strength, to resist penetration of nails, etc., as the ordinary commercial form of gas pipes of the same size, may be used as conduits, provided their interior surfaces are smooth and free from burrs; pipe to be galvanized, or the interior surfaces coated or enamelled to prevent oxidization with some substance which will not soften so as to become sticky and prevent wire from being withdrawn from the pipe.

k. All elbows must be made for the purpose, and not bent from lengths of pipe. The radius of the curve of the inner edge of any elbow, not to be less than three and one-half inches. Must have not more than the equivalent of four quarter bends from outlet to outlet, the bends at the outlets not being counted.

42. WOODEN MOULDINGS—(For wiring rules, see No. 24.)

a. Must have, both outside and inside, at least two coats of waterproof paint, or be impregnated with a moisture repellent.

b. Must be made of two pieces, a backing and a capping so constructed as to thoroughly incase the wire, and provide a one-half inch tongue between the conductors, and a solid backing, which, under grooves, shall not be less than three-eighths of an inch in thickness, and must afford suitable protection from abrasion.

It is recommended that only hardwood moulding be used.

48 SWITCHES—(See Nos. 17 and 22.)

a. Must be mounted on non-combustible, non-absorptive, insulating bases, such as slate or porcelain.

b. Must have carrying capacity sufficient to prevent undue heating.

c. Must, when used for service switches, indicate, on inspection, whether the current be "on" or "off."

d. Must be plainly marked where it will always be visible, with the name of the maker and the current and voltage for which the switch is designed.

e. Must, for constant potential systems, operate successfully at fifty per cent. overload in amperes, with twenty-five per cent. excess voltage under the most severe conditions they are liable to meet with in practice.

f. Must, for constant potential systems, have a firm and secure contact; must make and break readily, and not stop when motion has once been imparted by the handle.

g. Must, for constant current systems, close the main circuit and disconnect the branch wires when turned "off"; must be so constructed that they shall be automatic in action, not stopping between points when started, and must prevent an arc between the points under all circumstances. They must indicate, upon inspection, whether the current be "on" or "off".

44. CUT-OUTS AND CIRCUIT BREAKERS—(For installation rules, see Nos. 17 and 21.)

a. Must be supported on bases of non-combustible, non-absorptive insulating material.

b. Cut-outs must be provided with covers, when not arranged in approved cabinets, so as to obviate any danger of the melted fuse metal coming in contact with any substance which might be ignited thereby.

c. Cut-outs must operate successfully, under the most severe conditions they are liable to meet with in practice, on short circuits with fuses rated at 50 per cent. above and with a voltage 25 per cent. above the current and voltage for which they are designed.

d. Circuit-breakers must operate successfully, under the most severe conditions they are liable to meet with in practice, on short circuits when set at 50 per cent. above the current, and with a voltage 25 per cent. above that for which they are designed.

e. Must be plainly marked where it will always be visible, with the name of the maker, and current and voltage for which the device is designed.

45. FUSES—(For installation rules, see Nos. 17 and 21.)

a. Must have contact surfaces or tips of harder metal having perfect electrical connection with the fusible part of the strip.

b. Must be stamped with about eighty per cent. of the maximum current they can carry indefinitely, thus allowing about 25 per cent. overload before fuse melts.

With naked open fuses, of ordinary shapes and not over 500 amperes capacity, the maximum current which will melt them in about five minutes may be safely taken as the melting point, as the fuse practically reaches its maximum temperature in this time. With larger fuses a longer time is necessary.

Inclosed fuses where the fuse is often in contact with substances having good conductivity to heat, and often of considerable volume, require a much longer time to reach a maximum temperature on account of the surrounding material which heats up slowly. This data is given to facilitate testing.

c. Fuse terminals must be stamped with the maker's name, initials, or some known trade mark.

46. CUT-OUT CABINETS—

a. Must be so constructed, and cut-outs so arranged, as to obviate any danger of the melted fuse metal coming in contact with any substance which might be ignited thereby.

A suitable box can be made of marble, slate or wood, strongly put together, the door to close against a rabbet so as to be perfectly dust tight, and it should be hung on strong hinges and held closed by a strong hook or catch. If the box is wood the inside should be lined with sheets of asbestos board about one-sixteenth of an inch in thickness, neatly put on and firmly secured in place by shellac and tacks. The wires should enter through holes bushed with porcelain bushings; the bushings tightly fitting the holes in the box, and the wires tightly fitting the bushings (using tape to build up the wire, if necessary) so as to keep out the dust.

47. SOCKETS—(See No. 27.)

a. No portion of the lamp socket, or lamp base, exposed to contact with outside objects, must be allowed to come in electrical contact with either conductor.

b. Must, when provided with keys, comply with the requirements for switches. (See No. 43.)

48. HANGER-BOARDS—

a. Hanger-boards must be so constructed that all wires and current carrying devices thereon shall be exposed to view and thoroughly insulated by being mounted on a non-combustible, non-absorptive insulating substance. All switches attached to the same must be so constructed that they shall be automatic in their action, cutting off both poles to the lamp, not stopping between points when started and preventing an arc between points under all circumstances.

49. ARC LAMPS—(For installation rules, see No. 19.)

a. Must be provided with reliable stops to prevent carbons from falling out in case the clamps become loose.

b. Must be carefully insulated from the circuit in all their exposed parts.

c. Must, for constant current systems, be provided with an approved hand switch, also an automatic switch that will shunt the current around the carbons, should they fail to feed properly.

The hand switch to be approved, if placed anywhere except on the lamp itself, must comply with requirements for switches on hanger-boards, as laid down in Rule 48.

50. SPARK ARRESTERS—(See No. 19c.)

a. Spark arresters must so close the upper orifice of the globe that it will be impossible for any sparks thrown off by the carbons to escape.

51. INSULATING JOINTS—(See No. 26a.)

a. Must be entirely made of material that will resist the action of illuminating gases, and will not give way or soften under the heat of an ordinary gas flame or leak under a moderate pressure. They shall be so arranged that a deposit of moisture will not destroy the insulating effect, and shall have an insulating resistance of at least 250,000 ohms between the gas-pipe attachments, and be sufficiently strong to resist the strain they will be liable to be subjected to in being installed.

b. Insulating joints having soft rubber in their construction will not be approved.

52. RESISTANCE BOXES AND EQUALIZERS—(For installation rules, see No. 4.)

a. Must be equipped with metal, or with other non-combustible frames.

The word "frames" in this section relates to the entire case and surroundings of the rheostat, and not alone to the upholding supports.

53. REACTIVE COILS AND CONDENSERS—

a. Reactive coils must be made of non-combustible material, mounted on non-combustible bases and treated, in general, like sources of heat.

b. Condensers must be treated like apparatus operating with equivalent voltages and currents. They must have non-combustible cases and supports, and must be isolated from all combustible materials and, in general, treated like sources of heat.

54. TRANSFORMERS—(For installation rules, see Nos. 11 and 33.)

a. Must not be placed in any but metallic or other non-combustible cases.

55. LIGHTNING ARRESTERS—(For installation rules, see No. 5.)

a. Must be mounted on non-combustible bases, and must be so constructed as not to maintain an arc after the discharge has passed, and must have no moving parts.

CLASS E.—MISCELLANEOUS.

56. INSULATION RESISTANCE—

The wiring in any building must test free from grounds, i.e., the complete installation must have an insulation between conductors and between all conductors and the ground (not including attachments, sockets, receptacles, etc.) of not less than the following:

Up to	5 amperes	4,000,000
"	10	2,000,000
"	25	800,000
"	50	400,000
"	100	200,000
"	200	100,000
"	400	50,000
"	800	25,000
"	1,600 and over	12,500

All cut-outs and safety devices in place in the above.

Where lamp sockets, receptacles and electroliers, etc., are connected, one-half of the above will be required.

57. PROTECTION AGAINST FOREIGN CURRENTS—

a. Where telephone, telegraph or other wires, connected with outside circuits, are bunched together within any building, or where inside wires are laid in conduits or ducts with electric light or power wires, the covering of such wires must be fire-resisting, or else the wires must be enclosed in an air-tight tube or duct.

b. All aerial conductors and underground conductors, which are directly connected to aerial wires, connecting with telephone, telegraph, district messenger, burglar-alarm, watch-clock, electric-time and other similar instruments, must be provided near the point of entrance to the building with some approved protective device which will operate to shunt the instruments in case of a dangerous rise of potential, and will open the circuit and arrest any abnormal current flow. Any conductor normally forming an innocuous circuit may become a source of fire hazard if crossed with another conductor charged with a relatively high pressure.

Protectors must have a non-combustible insulating base, and the cover to be provided with a lock similar to the lock now placed on telephone apparatus or some equally secure fastening, and to be installed under the following requirements:

1. The protector to be located at the point where the wires enter the building, either immediately inside or outside of the same. If outside, the protector to be enclosed in a metallic, waterproof case.

2. If the protector is placed inside of building, the wires of the circuit from the support outside to the binding posts of the protector to be of such insulation as is approved for service wires of electric light and power (see No. 40a) and the holes through the outer wall to be protected by bushing the same as required for electric light and power service wires.

3. The wire from the point of entrance to the protector to be run in accordance with rules for high potential wires, i.e., free of contact with building and supported on non-combustible insulators.

4. The ground wire shall be insulated, not smaller than No. 16 B. & S. gauge copper wire. This ground wire shall be kept at least three inches from all conductors, and shall never be secured by uninsulated, double-pointed tacks, and must be run in as straight a line as possible to the ground connection.

5. The ground wire shall be attached to a water pipe, if possible, otherwise may be attached to a gas pipe. The ground wire shall be carried to, and attached to, the pipe outside of the first joint or coupling inside the foundation walls, and the connection shall be made by soldering, if possible. In the absence of other good ground, the ground shall be made by means of a metallic plate or a bunch of wires buried in a permanently moist earth.

58. ELECTRIC GAS LIGHTING—

Where electric gas lighting is to be used on the same fixture with the electric light:

a. No part of the gas piping or fixture shall be in electric connection with the gas lighting circuit.

b. The wires used with the fixtures must have a non-inflammable insulation, or, where concealed between the pipe and shell of the fixture, the insulation must be such as required for fixture wiring for the electric light.

c. The whole installation must be free from "grounds."

d. The two installations must test perfectly free from connection with each other.

59. SOLDERING FLUID—

a. The following formula for soldering fluid is suggested:

Saturated solution of zinc chloride	5 parts.
Alcohol	4 parts.
Glycerine	1 part.

CLASS F.—MARINE WORK.

60. GENERATORS—

a. Must be located in a dry place.

b. Must have their frames insulated from their bed-plates.

c. Must each be provided with a waterproof cover.

d. Must each be provided with a name-plate, giving the maker's name, the capacity in voltage and amperes and normal speed in revolutions per minute.

61. WIRES.

a. Must have an approved insulating covering.

The insulation for all conductors, except for portables, to be approved, must be at least one-eighth inch in thickness and be

covered with a substantial waterproof and flameproof braid. The physical characteristics shall not be affected by any change in temperature up to 200 degrees Fahrenheit. After two weeks' submersion in salt water at 70 degrees Fahrenheit it must show an insulation resistance of one megohm per mile after three minutes' electrification, with 550 volts.

b. Must have no single wire larger than No. 12 B. & S. Wires to be stranded when greater carrying capacity is required. No single solid wire smaller than No. 14 B. & S., except in fixture wiring, to be used.

Stranded wires must be soldered before being fastened under clamps or binding screws, and when they have a conductivity greater than No. 10 B. & S. copper wire, they must be soldered into lugs.

c. Must be supported in approved moulding, except at switchboards and portables.

Special permission may be given for deviation from this rule in dynamo rooms.

d. Must be bushed with hard rubber tubing one-eighth inch in thickness when passing through beams and non-water-tight bulkheads.

e. Must have when passing through water-tight bulkheads and through all decks, a metallic stuffing tube lined with hard rubber. In case of deck tubes they shall be boxed near deck to prevent mechanical injury.

f. Splices or taps in conductors must be avoided as far as possible. Where it is necessary to make them, they must be so spliced or joined as to be both mechanically and electrically secure without solder. They must then be soldered, to insure preservation, covered with an insulating compound equal to the insulation of a wire, and further protected by a waterproof tape. The joint must then be coated or painted with a waterproof compound.

62. PORTABLE CONDUCTORS—

a. Must be made of two stranded conductors, each having a carrying capacity equivalent to not less than No. 14 B. & S. wire, and each covered with an approved insulation and covering.

Where not exposed to moisture or severe mechanical injury, each stranded conductor must have a solid insulation at least one-thirty-second of an inch in thickness, and must show an insulation resistance between conductors, and between either conductor and the ground, of at least one megohm per mile after one week's submersion in water at seventy degrees Fahrenheit and after three minutes' electrification, with 500 volts, and be protected by a slow-burning, tough-braided outer covering.

Where exposed to moisture and mechanical injury—as for use on decks, holds and fire-rooms—each stranded conductor shall have a solid insulation, to be approved, of at least one-thirty-second of an inch in thickness and protected by a tough braid. The two conductors shall then be stranded together, using a jute filling. The whole shall then be covered with a layer of flax, either woven or braided, at least one-thirty-second of an inch in thickness, and treated with a non-inflammable, waterproof compound. After one week's submersion in water at seventy degrees Fahrenheit, with 550 volts and a three minutes' electrification, must show an insulation between the two conductors, or between either conductor and the ground, of one megohm per mile.

63. BELL OR OTHER WIRES—

a. Shall never be run in same duct with lighting or power wires.

64. TABLE OF CAPACITY OF WIRES—

B. & S. G.	Area Actual C. M.	No. of Strands.	Size of Strands B. & S. G.	Amperes.
19	1,288	..	..	..
18	1,674	..	..	3
17	2,048	..	..	..
16	2,583	..	..	6
15	3,257	..	..	..
14	4,107	..	..	12
12	6,530	..	..	17
..	9,010	7	19	21
..	11,368	7	18	25
..	14,336	7	17	30
..	18,081	7	16	35
..	20,799	7	15	40
..	30,856	19	18	50
..	38,922	19	17	60
..	49,077	19	16	70
..	60,088	37	18	85
..	75,776	37	17	100
..	90,64	61	18	120
..	124,928	61	17	145
..	157,563	61	16	170
..	198,677	61	15	200
..	250,527	61	14	235
..	296,387	91	15	70
..	373,737	91	14	320
..	413,639	127	15	340

EDUCATIONAL DEPARTMENT

INTRODUCTORY

After mature deliberation the publisher of this journal has decided to devote a certain amount of space each month to what may be termed an Educational Department, wherein both mechanical and electrical formula and mathematical problems will be discussed, illustrated, and as far as possible rule and example given. At the request of the editor, I have with pleasure undertaken to contribute to this department regularly each month, and before discussing actual mathematical problems, wish to briefly introduce the subject at issue.

The primary object of this department is chiefly to increase the value of an already valuable paper, by placing in the hands of every engineer who has any knowledge of the rudimentary principles of mathematics, such matter as will enable him by a little study to master the most intricate mechanical and electrical formula. Many of our most valuable engineering works and publications from time to time contain formula that is in many cases but vaguely understood, and very often entirely misunderstood, thus rendering an otherwise valuable work practically valueless to the reader.

Just at what particular point our calculations should commence became a matter of serious thought, and past experience had to be carefully considered, bearing in mind the fact that there are many really good engineers whose early education has, through force of circumstances, been deficient, and many others who, through lack of opportunity, have not been able to review their early education for years. Knowing by observation and experience the great necessity of having a thorough elementary education before attempting to digest and calculate problems, and the almost utter impossibility of the student arriving at a satisfactory conclusion of his studies without a thorough knowledge of the principle of mathematics involved, I have decided to commence at a point and carry out the programme outlined in this journal—commencing at the foundation and advancing by easy stages until the principles underlying the most obtuse and difficult formula can be readily explained and easily understood. The advantages to be derived from an education of this kind, coupled with practical mechanical ability, is too well understood to require comment.

The programme which has been outlined for the succeeding nine months will embrace:

DECIMAL FRACTIONS—Definitions and explanation of principles of, and method of reduction to common fractions, and vice versa.

SQUARE AND CIRCULAR MEASURE—Definition and explanation and practical demonstrations of.

CUBICAL AND CYLINDRICAL MEASUREMENTS—Definitions and explanations of, with practical hints.

SQUARE AND CUBE ROOT—Definitions and explanations of.

SAFETY VALVE CALCULATIONS—(Spring and Lever Types)—Principles of, with practical demonstrations.

BOILER CONSTRUCTION—Stays, rivets, joints and seams, iron and steel plate—strength of, with formula and practical demonstrations.

It is not the intention to fill these columns with a mass of figures hastily compiled without reference to any particular object; on the contrary, every problem will be carefully thought out, and only such information given as will be of use to you, and an effort will be made, based on experience and a knowledge of the requirements, to make this series of tests complete in every particular.

WM. THOMPSON.

[ARTICLE V.]

SAFETY VALVE CALCULATIONS.

ALL boilers should be fitted with two safety valves, one of which should be a lock-up valve, and set by the Boiler Inspector under whose immediate control it is.

The Canada Steamboat Act provides that every safety valve must have a lift equal to at least one-fourth of its diameter; the openings for the passage of steam to and from the valve must each have an area not less than the area of the valve, as must also all waste steam pipes, etc., and the area of a safety valve must equal one-half inch for each square foot of grate surface in or under the boiler.

LEVER TYPE.

Find the diameter of a safety valve required for a boiler whose grate bars are 5 feet long and furnace 3 feet wide.

We first find number of square feet of grate surface; then divide by 2, which gives area of valve in inches; square root of area divided by .7854 equals diameter,

$$\text{then } \frac{L \times W}{2} = A$$

$$\text{and } \sqrt{A \div .7854} = D.$$

Where L equals length of grate bars,

W equals width of furnace,

A equals area of valve in inches,

D equals required diameter of valve.

$$\frac{5 \times 3}{2} = 7.5 \text{ sq. inches.}$$

$$7.5 \div .7854 = 9.549.$$

Square root of 9.549 equals 3.09 inches; then required diameter of valve is 3.09 inches, say $3\frac{1}{8}$ inches.

Example (2): What weight is required to be placed 2 inches from the end of a safety valve lever to equal a boiler pressure of .50 pounds to the square inch, the diameter of valve being $3\frac{1}{8}$ inches, the distance from fulcrum to valve 6 inches, and total length of lever from fulcrum 16 inches? The weight of valve and stem is 15 pounds, and effective moment of lever 80 inch pounds.

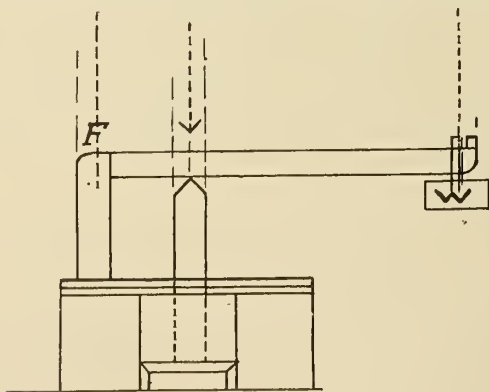


Fig. I

Since the steam pressure within the boiler and consequently pressing against the lower face of the valve and trying to unseat it, equals so many pounds per square inch, we must first find the

area of the valve in square inches, to ascertain the whole force tending to raise the valve, but since the weight of the valve, spindle and lever acts downwards and against the upward pressure of the steam, we must make allowance for this, and the remaining force is that which we have to counteract by weight.

In diagram No. 1 F is the fulcrum, V is the point where pressure is exerted, W is the weight, FV is 6 inches, VW is 10 inches, and FW is 16 inches.

The principle of the lever is: The weight or force multiplied by its distance from the fulcrum is equal to the weight or pressure on the valve multiplied by its distance from the fulcrum,

$$\text{or, } W \times FW = V \times FV.$$

But the steam pressure has, in addition to the actual weight of W, also to overcome the moment of the lever, which is found by weighing the lever and finding how far its balancing point is from F; then this distance multiplied by its weight is the effective moment of the lever, which we will call A.

$$\text{Then } W \times FW + A = V \times FV;$$

that is, the total force at work keeping the valve down is equal to the force or pressure endeavoring to lift it off its seat.

In accordance, then, with these principles, we get the following rules:

(1) Find the area of the valve and multiply it by the pressure per square inch.

(2) From the product take the weight of the valve and stem; the remainder is the V of the formula.

(3) Multiply "the remainder by the distance from the fulcrum to the valve," FV, then subtract the moment of the lever, and divide by "the distance from the fulcrum to the weight," FW, found by adding "the distance from the fulcrum to the valve" to that "from the valve to the weight."

$$3.125 \times 3.125 \times .7854 = 7.67, \text{ area of valve.}$$

$$7.67 \times 50 = 383.50, \text{ pressure against valve.}$$

$$383.5 - 15 = 368.5, \text{ effective upward weight.}$$

$$368.5 \times 6 \text{ FV} = 2211.0, \text{ effective moment lifting lever.}$$

$$2211 - 80 \text{ (effective moment of lever acting downwards)} = 2211 - 80 = 2131.$$

$$2131 \div 16 = 133.2, \text{ required weight of W.}$$

NOTE: For extreme accuracy it is necessary to take note of the weight of the valve and its parts, and also of the moment of the lever; but in a great many cases this is entirely omitted. Then a question of this kind becomes simplified thus:

$$W = \frac{\text{area} \times \text{pressure} \times \text{FV}}{\text{FW}}$$

TO GRADUATE A SAFETY VALVE LEVER.

We have a safety valve $\frac{1}{4}$ inches in diameter, and spindle presses against a point in the lever that is $\frac{1}{4}$ inches from the fulcrum; how far must a weight of 120 pounds be placed from the fulcrum to equal a boiler pressure of 60 pounds to the square inch, when the valve weighs 8 pounds and effective moment of the lever is 50 inch pounds. Also give the graduation marks on the lever for 40 and 50 pounds pressure with the same weight.

$$\text{Formula } V = \text{area} \times \text{pressure} - 8.$$

$$\text{FW} = \frac{V \times \text{FV} - 50}{W}$$

In this question we require to find distance, FW. We first find area of valve; multiply this by pressure per square inch, and then subtract weight of valve and parts bearing downward to get total

effective upward pressure; this equals V of formula. Now multiply total upward pressure by distance fulcrum to valve and subtract effective moment of lever; result, divided by weight, equals distance fulcrum to weight.

$$\begin{aligned} 4 \times 4 &= 16 \times .7854 = 12.5664, \text{ area valve.} \\ 12.5664 \times 60 &= 753.98, \text{ total pressure.} \\ 753.98 - 8 &= 745.98, V, \text{ total effective pressure.} \\ 745.98 \times 4 &= 2983.92, \text{ total moment of valve.} \\ 2983.92 - 50 &= 2933.92, \text{ total effective moment of valve.} \\ 2933.92 \div 120 &= 24.45 \text{ inches distance FW.} \end{aligned}$$

Since the distance $FW = 24.45$ inches for a pressure of 60 pounds to the square inch, we can find what distance represents a pressure of 10 pounds by dividing this distance by 6, the number of times 10 is contained in 60.

$$24.45 \div 6 = 4.07.$$

Then for each additional 10 pounds pressure we require to move the weight a distance of 4.07 inches further from the fulcrum, and to find the distance from the fulcrum equal to a pressure of 40 pounds, this distance multiplied by 4 = FW ; therefore,

$$FW \text{ at 50 pounds pressure} = 4.07 \times 5 = 20.35 \text{ ins.}$$

$$FW \text{ at 40 pounds pressure} = 4.07 \times 4 = 16.28 \text{ ins.}$$

Required to find distance from fulcrum to valve, boiler pressure being 50 pounds to square inch; diameter of valve, 4 inches; weight of valve and spindle, 10 pounds; distance valve to weight, 12 inches, and weight 150 pounds; moment of valve lever, 40 inch pounds.

Formula:

$$FW = \frac{VW \times W + \text{moment}}{V}$$

$$\begin{aligned} 4^2 \times .7854 &= 12.5664 \text{ square inches.} \\ 12.5664 \times 50 &= 628.32, \text{ total pressure.} \\ 628.32 - 10 &= 618.32, \text{ total effective upward pressure, or } V. \\ 12 \times 150 &= 1800 \text{ pounds.} \\ 1800 \div 40 &= 45, \text{ total weight acting downwards at } V. \\ 45 \div 618.32 &= 2.975 \text{ inches distance } FW; \text{ or distance } FW \text{ is nearly 3 inches.} \end{aligned}$$

SUMMARY.

TO FIND effective moment of lever, multiply weight of lever by distance from its balancing point or centre of gravity to fulcrum, and divide by distance from centre of valve stem to fulcrum. Result will be effective moment of lever in inch pounds, or the weight required to raise valve off its seat with nothing but lever holding against steam.

TO FIND actual effective weight of ball, divide weight of ball by distance from fulcrum to valve stem, and multiply quotient by distance from ball to fulcrum.

TO FIND length of lever, add together effective moment of lever and weight of valve and stem, and subtract from total pressure acting upwards against valve. Divide remainder by weight of ball, and multiply quotient by distance from stem to fulcrum.

TO FIND weight of ball, add together the effective moment of lever and weight of valve and stem, and subtract this sum from total pressure against valve at blowing-off point. Multiply remainder by distance from fulcrum to stem, and divide quotient by length of lever from fulcrum to weight.

TO FIND diameter of valve to blow off at given pressure, add together effective moment of lever, weight of valve and stem, and effective weight of ball. Divide this sum by gauge pressure, and result will be required area of valve.

Square root of area divided by .7854 equals diameter.

TO FIND pressure at which a boiler will blow off, add together effective moment of lever, weight of valve and stem, and effective weight of ball. Divide this sum by area of valve in square inches. Result will be gauge pressure at which safety valve will act.

FUNDAMENTAL PRINCIPLES OF ELECTRIC ENERGY.

COMMON UNITS OF MEASURE.

The units commonly met with by engineers in the study of the principles underlying the generation, transmission and use of electricity are the volt, ampere, ohm and watt.

In diagram No. 1 A is a dynamo or electric battery, and the source of electric energy, and the purpose of which is to produce a difference in potential between the terminals B and B_1 . This difference in potential is measured in volts, and we say that between the terminals B and B_1 there exists an electric potential or pressure of so many volts, written symbolically (E.M.F.)

Let us now suppose that a difference in potential exists between B and B_1 , and that B is the point of higher pressure; if we connect B and B_1 together by a substance capable of conducting electricity, there will be a flow from B to B_1 . This flow of electricity is known as a current and measured as amperes.

The rate at which current will flow from B to B_1 when joined together by a conductor as at C depends upon following conditions: 1st, upon the difference in pressure or electric potential between B and B_1 ; 2nd, upon cross section or area of conductor

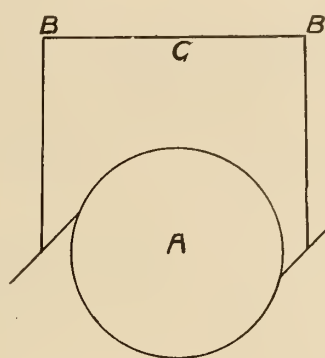


Fig. I

C , and upon length of C and nature of material of which C is composed; or, in other words, we may say that the rate at which current will flow through conductor C depends upon the difference in pressure and upon resistance offered by C to current.

Therefore, the greater the difference in potential the greater the current.

When a current flows through a conductor there is a loss in potential or voltage caused by the resistance of the conductor. This resistance is measured in ohms, and consequently a conductor is said to have a resistance of so many ohms.

When a difference in potential exists between B and B_1 , but no connection between them, there is no flow of current through the dynamo or generator A , and therefore no work will be done by it. But if conductor C is connected to terminals B and B_1 , current will at once begin to flow, and A will be compelled to do work to keep up the flow. The rate at which this work will be done will depend upon difference in potential between terminals B and B_1 , and upon quantity of current flowing through the circuit. This then becomes the electrical energy or rate of doing work, and the electric unit of work or energy is the watt, and, in accordance with above, equals the volts multiplied by the amperes, or by the potential in volts multiplied by current in amperes.

The watt, then, is the product of one volt and one ampere, and in energy or work is equal to $\frac{1}{746}$ h.p., or 746 watts are equivalent to the mechanical force necessary to raise 550 pounds one foot high in one second, or 33,000 pounds one foot high in one minute.

The kilo-watt, as the name implies, equals 1,000 watts.

The symbols commonly used in formula to represent the units above described are as follows:

E. or E.M.F. equals electro motive force or volts.

C., the current or amperes.

R., the resistance or ohms.

W., or watts, represents the electrical energy.

K.W. represents kilo-watts.

(To be Continued.)

TRADE NOTES.

The Goldie & McCulloch Company, of Galt, have installed new engines for the Oshawa Malleable Iron Works Company.

The Canadian General Electric Company are installing an 150 light incandescent plant for the estate of Ross Bros., Buckingham, Que.

The New York offices of the Western Electric Company have been removed to their new building at 57-67 Bethune street. The retail store in the Thames street building is still retained.

The Rogers Electric Company, of London, Ont., are installing electric lights in the Anderson Furniture Company's factory, Woodstock, under sub-contract from the Stevens Manufacturing Company.

We are advised that the Montreal Street Railway Company, after a careful investigation of the merits of the various types of motors operated on their roads, have placed an order for fifty additional G.E. 1,000 motors with the Canadian General Electric Company.

The Toronto Electric Motor Company have recently placed a 600 incandescent light plant in the Methodist Book & Publishing Company's building, Toronto. The dynamo is direct connected with Ideal engine, manufactured by Goldie & McCulloch, of Galt.

The Ottawa Car Company have received an order from the Hamilton, Grimshy and Beamsville Railway Company for two cars of new design, to be 50 feet in length, with baggage and mail compartments. These are said to be the largest street railway cars yet manufactured in Canada.

The Canadian General Electric Company have received an order for a 2,000 light, single phase alternator for Revelstoke, B. C. This machine, which will be of their standard iron-clad revolving armature type, compounded to secure automatic regulation, will be used to supply incandescent lighting in Revelstoke and vicinity.

The Toronto Electrical Works has been reorganized and is now known as the Toronto Electrical Works Co., Limited. The company's offices and works have also been removed to commodious premises at 40 to 42 Adelaide Street West. Simultaneously with the above mentioned changes, the company have issued a new and comprehensive catalogue.

ELECTRIC RAILWAY DEPARTMENT.

AN ESTEEMED STREET RAILWAY MANAGER.

As a result of the control of the Birmingham street railway passing into the hands of Canadian capitalists, this country is to lose one of its most popular railway managers, in the person of Mr. Granville C. Cunningham, manager of the Montreal street railway. In company with Mr. Ross, Mr. Cunningham visited England recently, when the negotiations for securing the franchise of the Birmingham road were pending, and now comes the announcement that he has been appointed manager of the Birmingham system, while he is succeeded as manager of the Montreal road by Mr. F. L. Wanklyn, who recently took charge of the Toronto railway system.

Mr. Cunningham's removal to England is much regretted in street railway circles, not alone by his confreres in other cities, but by the employees under him. As an evidence of this the employees of the Montreal



MR. GRANVILLE C. CUNNINGHAM.

street railway assembled at the Monument National Hall on the 20th ultimo. There were present Messrs. Duncan McDonald, superintendent; F. P. Brothers, superintendent of construction; J. S. Vindin, engineer; M. Watt, secretary; N. Graburn, assistant superintendent; L. Landers, cashier; T. Casey, storekeeper; A. Alexander, engineer of power house; W. G. Ross, controller; H. R. Lockhart, electrician; Dr. Mount, medical officer to the company; George Strubbe, claims agent; D. McQuaid, foreman carpenter; H. Taylor, mechanical superintendent, and probably 800 conductors, motormen and other employees. Mr. McDonald read the following address:

GRANVILLE C. CUNNINGHAM, ESQ:

DEAR SIR,—We, the officers and employees of the Montreal Street Railway Company, have, with feelings of deepest regret, heard the announcement of your resigning the management of the company, and feel that we cannot permit the occasion to pass without giving expression to the deep sense of the loss which we are about to sustain. In our past connection we have always experienced at your hands that just and fair treatment, patient consideration and courtesy which have won for you our esteem and regard, and made the

severance of your connection with the company a personal loss to all of us.

While moved with feelings of regret that the relationship between us is about to cease, we cannot but feel gratified that you have been called upon to assume a charge of greater importance and responsibility, and in this and every future position that you may be called upon to fill, we offer to you our best wishes, and we pray that long life, health and happiness may be granted to both Mrs. Cunningham and yourself.

With this expression of our warmest feelings and regrets at your departure, we beg you to accept the accompanying remembrance.

Signed on behalf of the officers and employees of the Montreal Street Railway Company.

The address was accompanied by a magnificent silver tea and coffee set and a beautifully mounted cane, accompanied by an illuminated address, which was framed and contained the portrait of the recipient.

Mr. Cunningham, in replying, said the ovation was as unexpected as it was complimentary, and he thanked them all from the bottom of his heart. He referred to the reputation which the employees of the Montreal street railway enjoyed. It was only the other day, he said, that a gentleman from England had referred to the excessive kindness and politeness of the officials to the travelling public.

ROLLER BEARINGS FOR ELECTRIC TRACTION.

"ROLLER BEARINGS" was the title of a paper read before the British Association for the Advancement of Science at its recent convention in Toronto, by Mr. W. Bayley Marshall, M. Inst. C. E. The paper strongly advocated the employment of roller bearings for electric railways, and contained points of interest to railway people. Among the chief advantages claimed for these bearings by Mr. Marshall are great reduction in starting effort, decreased traction and revolving effort, and economy in lubrication.

Concerning their adaptability for electric traction he says: "In the case of electrical traction the reduced starting effort is of almost vital importance, as not only does it effect a very considerable saving in electrical output, but also greatly reduces the serious rush of current through the motors at the moment of starting, which rush is due to the fact that the motors and load have to be started at the same moment, with results most detrimental to the life of the motor. If the necessary effort can be materially reduced, there will be a large economy effected under the head of "Maintenance of Motors." The Liverpool overhead railway made their first trials with these roller bearings some two years ago, and are now gradually fitting them to the whole of their rolling stock, as they find that since their introduction they have, with a slight modification of their motors, been enabled to run three instead of two coach trains, the extra coach being without motors, thus increasing the carrying capacity of their trains by 50 per cent. The contention that the application of roller bearings in the case of electrical traction will show a great economy under the head of "Maintenance of Motors" has been amply borne out by the experience gained at Liverpool."

In describing the patent for roller bearings taken out

by Mr. Frederick Purdon, Mr. Marshall says : " The invention has developed into its present form by the following steps :—As first designed the bearing rollers were spaced by balls placed between each pair of rollers, two sets of balls being provided, one at each end. It was found that these balls had not sufficient controlling power to prevent the rollers from cross-winding. The next step was to substitute subsidiary rollers for the balls, and a theoretically perfect bearing was produced, its only fault being that it is too costly and complicated to allow of its application, except under special circumstances. The final step was the introduction of the floating stage, which, though not so theoretically perfect, has been found to give even better results in practice than the subsidiary roller design, and has the merit of great simplicity."

SPARKS.

The London street railway is now being extended to Pottersburg.

A project is said to be on foot to construct an electric street railway from Sarnia to Weisbeach.

A conductor on the Kingston street railway confessed to having been tapping the fare boxes for some time.

The Yarmouth Street Railway Company have purchased a 45 kilowatt generator from the Canadian General Electric Company.

It is probable that the Montreal Park & Island railway will be extended to L'Assomption. Steps looking to that end have already been taken.

The Toronto Street Railway Company are erecting a new three-storey brick office building at the north-west corner of King and Church streets.

Mr. Wm. Mackenzie, president of the Toronto Railway Company, has stated that Sunday cars in Toronto are a success from a financial standpoint.

The annual meeting of the shareholders of the Montreal Park & Island Railway Company will be held at the company's offices in Montreal on the 16th inst.

An American syndicate is said to be considering the construction of an electric street railway on Wells' Island, near Kingston, connecting Thousand Island Park, Fine View and Westminster Park. The distance is about seven miles.

The Chatham City & Suburban Railway Company, of which Mr. George C. Rankin is the chief promoter, desires power to extend its line north from the city, through the township of Dover to Mitchell's Bay, thence to Wallaceburg and Petrolia.

A special general meeting of the shareholders of the Winnipeg Electric Street Railway Company will be held in the city of Montreal on the 16th inst., to consider the offer made by the Manitoba Electric & Gas Light Company for the sale to the said railway company of their assets and plant.

The Lord's Day Alliance are opposing the running of street cars in Hamilton on Sunday, and have requested the Ontario government to carry the case to the Privy Council. The trial judge and the Court of Appeal dismissed the case against the company, adding that it could run cars on Sunday. It is improbable that the Ontario government will take any action in the matter.

The Aylmer Electric Light and Manufacturing Company, Aylmer, Ont., are installing an extensive incandescent lighting system. They have awarded the contract for the apparatus required for the plant to the Canadian General Electric Company. The generator will consist of a 60 kilowatt 1000 light standard single-phase alternator of the revolving iron-clad armature type, compounded to secure automatic regulation.

An interesting paper was read at the recent convention of the British Association for the Advancement of Science, by Mr. J. G. Waldrige, the title being, " The Present Tendency of Electric Tramway Traction." Mr. Waldrige stated that the United Kingdom had practically 130 miles of electric tramway ; of this length, 103½ miles are operated on the trolley or overhead wirey stem, 15¾ miles by means of a third rail conductor, 6 miles by storage batteries, and only 4 miles on the underground conduit system. These proportions, he thought, could be taken as fairly representative of other countries also. The tendency in Great Britain was in favor of the overhead wire system, the objections to which, in the past, had been entirely æsthetic. This system appeared likely to come into still greater use than has already been the case, if

only on the ground of economy. The ordinary underground conduit, with open slot, was most expensive to install and troublesome to maintain efficiency, the cost of construction sometimes reaching £12,000 per mile. Closed conduits with surface contacts usually operated by means of electro-magnetic switching devices in boxes under the street level are complicated, and it is to be feared are unreliable. The great weight of lead required on each car for accumulator traction means practically that the live paying load can never reach 25 per cent. of the gross weight of loaded car ; whilst the combinations of trolley wire and battery, attempted on systems like those of Hanover and Dresden, are obviously ill-designed, the dead weight of battery being carried throughout the entire journey, though it is only required for part thereof.

MOONLIGHT SCHEDULE FOR SEPTEMBER.

Day of Month.	Light.	Extinguish.	No. of Hours.
	H.M.	H.M.	H.M.
1.....	P. M. 7.50	A. M. 4.40	8.50
2.....	" 8.10	" 4.40	8.30
3.....	" 8.40	" 4.40	8.00
4.....	" 9.20	" 4.40	7.20
5.....	" 10.00	" 4.40	6.40
6.....	" 10.40	" 4.40	6.00
7.....	" 11.30	" 4.40	5.10
8.....	.....	" 4.40 }	4.40
9.....	A.M. 12.00	 }	
10.....	" 12.50	" 4.40	3.50
11.....	" 2.20	" 4.40	2.20
12.....	No light.	No light.	....
13.....	No light.	No light.	....
14.....	No light.	No light.	....
15.....	P. M. 7.00	P. M. 9.00	2.00
16.....	" 7.00	" 9.20	2.20
17.....	" 7.00	" 10.00	3.00
18.....	" 7.00	" 10.30	3.30
19.....	" 7.00	" 11.00	4.00
20.....	" 7.00	" 11.40	4.40
21.....	" 7.00	A. M. 12.30	5.30
22.....	" 7.00	" 1.10	6.10
23.....	" 7.00	" 2.10	7.10
24.....	" 7.00	" 3.20	8.20
25.....	" 7.00	" 4.30	9.30
26.....	" 6.40	" 4.50	10.10
27.....	" 6.40	" 4.50	10.10
28.....	" 6.40	" 4.50	10.10
29.....	" 6.40	" 4.50	10.10
30.....	" 6.40	" 4.50	10.10
.....	"		
Total,			168.20

MOONLIGHT SCHEDULE FOR OCTOBER.

Day of Month.	Light.	Extinguish.	No. of Hours.
	H.M.	H.M.	H.M.
1.....	P. M. 7.40	A. M. 5.00	9.20
2.....	" 7.40	" 5.00	9.20
3.....	" 7.40	" 5.00	9.20
4.....	" 11.20	" 5.00	5.40
5.....	.....	" 5.00 }	4.30
6.....	A.M. 12.30	 }	
7.....	" 1.50	A.M. 5.10	3.20
8.....	" 3.00	" 5.10	2.10
9.....	No light.	No light.	....
10.....	No light.	No light.	....
11.....	No light.	No light.	....
12.....	No light.	No light.	....
13.....	P. M. 6.00	P. M. 8.20	2.30
14.....	" 6.00	" 8.20	2.30
15.....	" 5.50	" 9.00	3.10
16.....	" 5.50	" 9.50	4.00
17.....	" 5.50	" 10.50	5.00
18.....	" 5.50	" 11.50	6.00
19.....	" 5.40	A. M. 12.50	7.10
20.....	" 5.40	" 2.00	8.20
21.....	" 5.40	" 3.20	9.40
22.....	" 5.40	" 4.30	10.50
23.....	" 5.40	" 5.20	11.40
24.....	" 5.40	" 5.20	11.40
25.....	" 5.40	" 5.20	11.40
26.....	" 5.40	" 5.20	11.40
27.....	" 5.50	" 5.20	11.30
28.....	" 6.00	" 5.20	11.20
29.....	" 6.50	" 5.30	10.40
30.....	" 7.50	" 5.30	9.40
31.....	" 7.50	" 5.30	9.40
Total,			202.20

SPARKS.

The ratepayers of Vernon, B. C., have sanctioned a by-law to borrow \$12,000 for an electric light plant.

The village of Grand Forks, B. C., has decided to borrow funds for the purchase of an electric light plant.

The Canadian General Electric Company are installing an incandescent lighting machine for the Toronto Paper Company at the Cornwall mills.

Messrs. I. Matheson & Co., Limited, of New Glasgow, N. S., have purchased an incandescent lighting generator from the Canadian General Electric Company.

It is reported that the Quebec government will shortly offer for sale the water power of the Shawenegan Falls, on the St. Maurice river, at an upset price of \$50,000.

The Electrical Power and Manufacturing Company, of Hamilton, have requested permission from the city to supply light and power. The capital stock is \$20,000.

The British Columbia Mills, Timber and Trading Co., of Vancouver, B. C., are lighting up their mills by electricity, the plant being furnished by the Royal Electric Co., Montreal.

It is learned that the Canadian General Electric Company are constructing a 75 kilowatt steel frame, direct connected, direct current generator for McGill University, Montreal.

The Canadian Pacific Railway Co. have recently largely increased the staff in their car shops at Perth, and are working overtime. The Royal Electric Co. is installing a plant in their shops.

Messrs. Champoux & Brother, D'Israeli, P. Q., are installing a 650 light alternating current dynamo, which they purchased from the Royal Electric Co. They are lighting the town and their mills.

In Germany the horse is being supplanted by electric power in ploughing. Engineering gives illustrations and description of machines constructed by A. Borsig, of Berlin, and used in the sugar plantations in that country with success.

As a result of the decision of the courts that the poles, wires, etc., of the Toronto Street Railway Company are assessable, the assessment commissioner of London has decided to assess similar plant owned by the street railway company in that city.

The Hamilton, Grimsby and Beamsville Railway Company were replacing the girder rails with T rails through the village of Stoney Creek, when the residents objected. Some of them are charged with turning the hose on the president and manager.

Incorporation has been granted to the Ballard Electric & Machine Co., Limited, with a capital of \$24,000, and head office in Toronto. The promoters are: P. E. Doolittle, Coventry, England; J. O. G. Ballard, G. L. Ballard, S. E. Ballard and H. T. Ballard, all of Toronto.

A company has been formed at Strathroy, Ont., composed of Messrs. H. McCall, John C. Scott, A. Reed, F. N. Saylor and G. M. Halldane, to extend the electric lighting business. It is the intention to enlarge the present building and install considerable new plant, including a generator.

The Exeter Light & Power Company, recently organized to take over the lighting business in Exeter formerly operated on a small scale by Captain Howard, have placed an order with the Canadian General Electric Company for a 1,000 light single-phase alternator, of their standard iron-clad armature compound-wound type.

The Canadian General Electric Company are installing a 75 kilowatt monocyclic generator for Messrs. Kilmer, Cowan & Co., of Southampton. This machine, which will be operated from a water-power, conveniently located, will supply current for incandescent lighting and power for the two neighboring towns of Southampton and Port Elgin.

Mr. E. E. Sheppard, in his report to the Department of Trade and Commerce on the possibilities of trade with Mexico, says: "The principal houses for telephone, telegraphic and electric light supplies of the United States are represented, and not only take large orders, but carry a more or less complete stock of general supplies. The business is developing into large proportions. To do business an agent and stock would be required at the capital."

Mr. Taylor, of the Taylor Hydraulic Company, Montreal, is at present in British Columbia, where a company has been formed, with a capital of \$1,000,000. It is expected that the hydraulic air compression system for the transmission of power will be brought into requisition in developing many of the mining properties on the coast. A plant is now being installed at the Ainsworth camp, the intention being to distribute the power over a radius of six miles.

The Kingsville Electric Light Co., a corporation recently organized

in that town, have decided to light the town, stores and residences by electricity, displacing natural gas, and for this purpose have bought from the Royal Electric Co. an "S.K.C." 500 light two-phase generator, with the necessary transformers and material requisite to wire up 500 lights, which is the amount they intend to start work with. The Kingsville Electric Co. have made a contract by which they use natural gas for fuel. They intend to furnish incandescent and arc lights as well as motors.

The Berlin Gas Co., of Berlin, have been operating an incandescent lighting plant on the three wire system, but are now extending the incandescent lighting service so as to furnish light to the residential portion of the town. They have decided to use an alternating current and have placed the order for the new equipment with the Royal Electric Co., using the "S.K.C." system throughout. They have just made extensive alterations in their station, and have now 2 100 k.w. Edison 500 volt generators for furnishing current to the Berlin & Waterloo Street Railway. They also operate a local power service from their three wire low tension system, besides furnishing the town with arc lamps, for which purpose they operate 2 50 light 4 amp. Ball dynamos.

The new electric locomotive recently shipped from the works of the Canadian General Electric Company to the Hull Electric Company, is by long odds the largest machine of the kind so far constructed in Canada. The motive power will be furnished by a four motor equipment of G.E. 51 motors, having at normal current input a capacity of 80 horse power each. The trucks are of the Maguire "L" pattern, with steel rim wheels. The body, which differs in operation and detail from the first locomotive supplied to the Hull Electric Company, was built for the Canadian General Electric Company by the Crossen Car Company, of Cobourg. We expect to furnish in our next issue complete detailed description of this interesting piece of apparatus, especially important as the fore-runner of many similar machines to be built for future heavy electric traction in the Dominion.

The Penman Manufacturing Co., of Paris, Ont., who operate some of the largest cotton mills in Canada, have made a number of improvements and additions to their mills in Paris, and among the improvements have decided to light the mill by electricity. The contract for a 500 light "S.K.C." machine and the wiring of the factories has been awarded to the Royal Electric Company, who purpose using for this their "S.K.C." two-phase alternating current apparatus, the dynamo wound to deliver to the mains current at a pressure that can be used directly in the lamps, from 100 to 115 volts. This is the first instance in Canada where alternating current is used for factory lighting, and the "S.K.C." is as far as we know the only machine that is interchangeable and can be used from 100 to 2000 volts with the same armature winding, the only thing necessary to change the voltage being to change the connections. It has been held heretofore by electrical manufacturers that it was not practical to use alternating current for factory lighting. This has been opposed for some time by the more advanced of dynamo builders, and in a short time we will have demonstrated the feasibility of the alternating current for this purpose.

PERSONAL.

Mr. J. W. Moyes, manager of the Metropolitan Street Railway, has been unanimously chosen by the Conservatives of East York as candidate for the local legislature.

It is reported that Mr. Duncan McDonald, Superintendent of the Montreal Street Railway, will shortly assume the duties of general manager of the Toronto Street Railway.

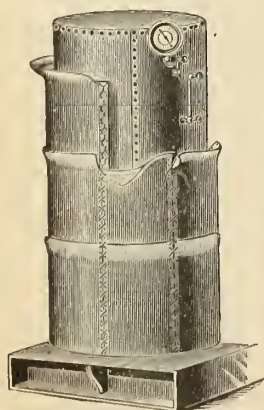
Mr. J. Alexander Culverwell, formerly connected with the Canadian General Electric Company, has been appointed local manager for Central Ontario of the London and Lancashire Insurance Company.

Mr. Wm. Barron, manager of the Brantford Electric Railway Company, was, in St. Basil's church in that city, united in marriage to Miss Emily Blanche. The ELECTRICAL NEWS extends congratulations.

Mr. W. H. Woodward, a noted English electrician of Wolverhampton, and who is said to be the proprietor of the largest electrical works in Great Britain, was a visitor in Toronto during the recent convention of the British Association for the Advancement of Science.

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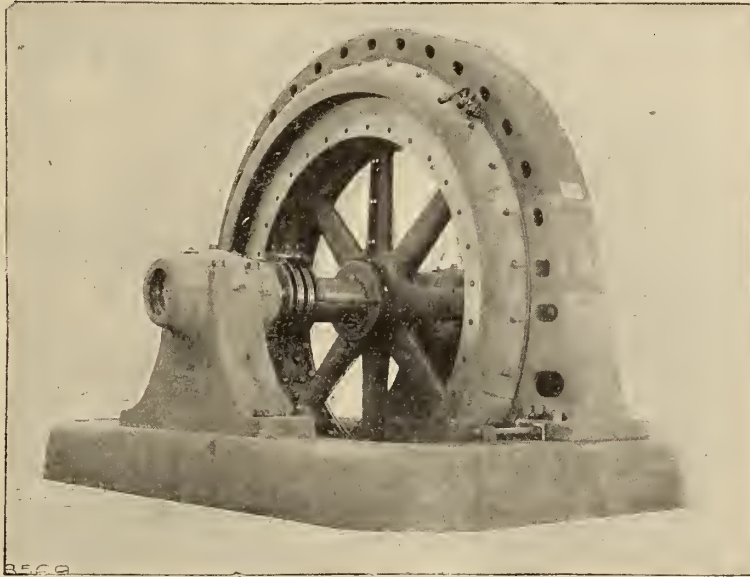
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SPARKS.

The management of the Royal Electric Co. have declared a quarterly dividend of 2 per cent., payable October 1st.

The Ottawa Street Railway Company have recently placed another dynamo in their power house at the Chaudiere, thus making five machines.

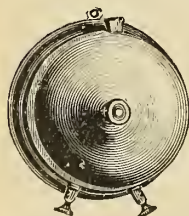
The Citizens' Electric Light Co., of Watford, Ont., have their plant in operation. The alternating system is used, the plant having a capacity of eight hundred 16 candle power lights.

The steamer "Esturion," of Lindsay, has recently been fitted with an electric light plant by Mr. Bruce McBurney. The system comprises 21 incandescent lights of 16 candle power light, and a 2000 candle power search light.

Mr. E. A. Wills, secretary of the Toronto Board of Trade, has received a letter from a correspondent in Alexandria, Egypt, in which it is pointed out that among other Canadian goods a market for belting and electrical supplies could be found in that country.

Incorporation has been granted to the Alaska Telegraph & Telephone Company, to build a telegraph line from Dyea to Dawson City, Alaska, with a branch to Juneau. A cable, containing both telegraph and telephone lines, will be laid, which will rest on the surface of the ground, no poles being used. The company is capitalized at \$250,000, and the directors are: C. W. Wright, Theodore Richard, D. E. Bohenan, J. W. Wright and J. F. Fassett.

The city council of Halifax, N. S., have now under consideration the question of street lighting, and will probably purchase an electric light plant to be operated by the city. An estimate of the cost of a suitable plant has been prepared by Mr. Colpitt, electrician, who states that an arc plant would cost about \$43,000 for 250 lights, and for 1,500 incandescent lights the cost of a plant would be \$6,000. The engineer has been asked to furnish a report regarding the available water power.



No. 43102.

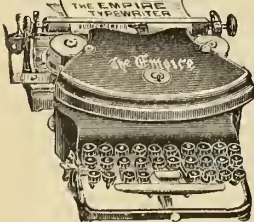
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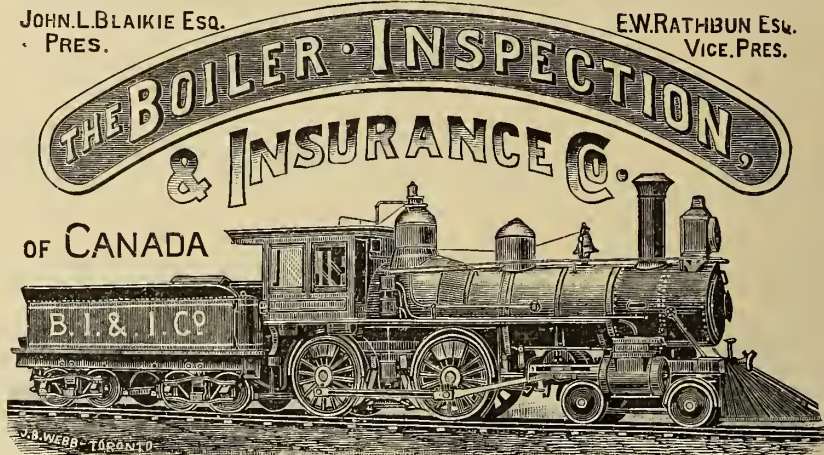
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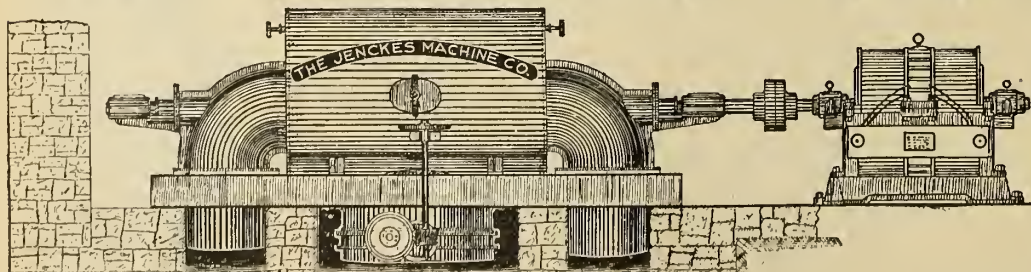
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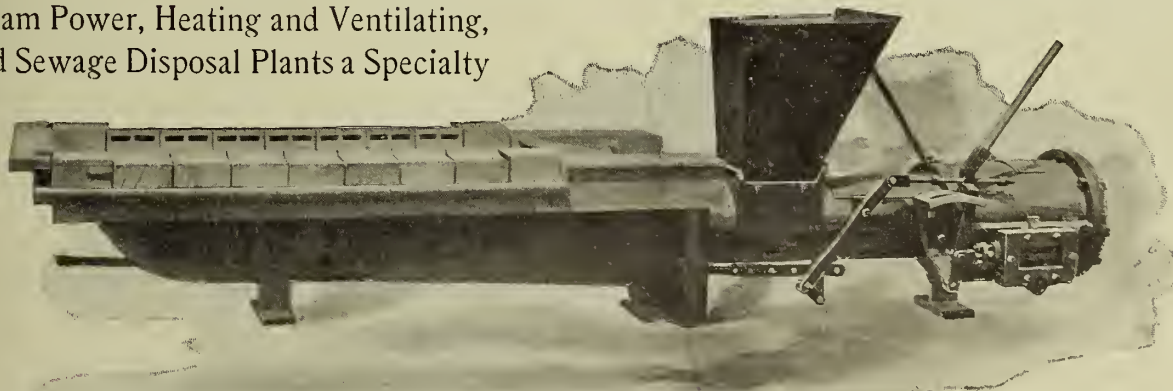
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OCTOBER, 1897

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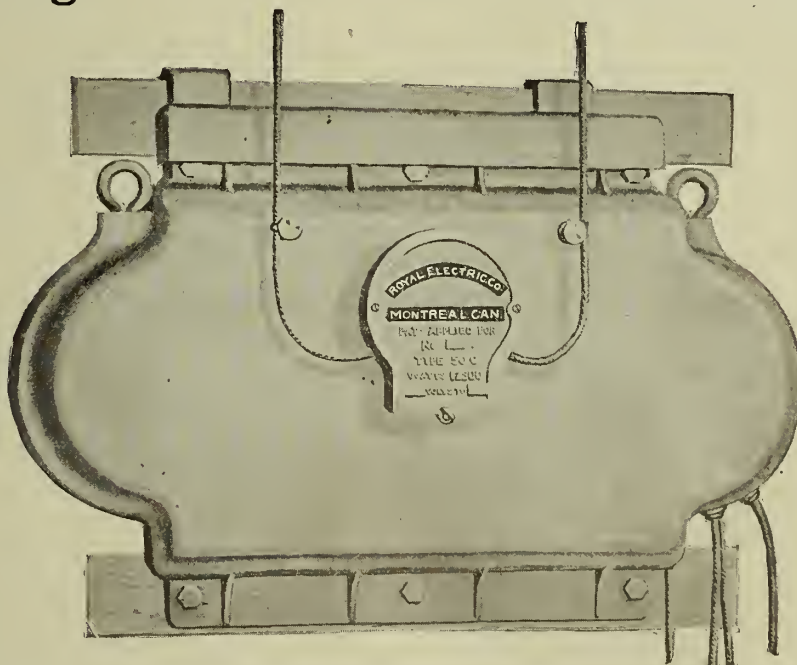
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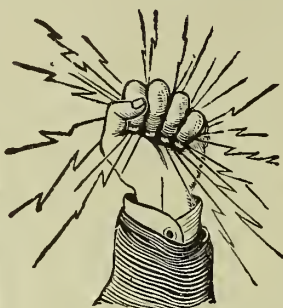
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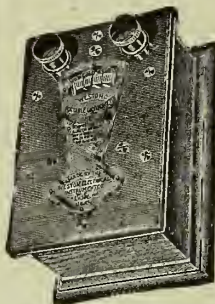
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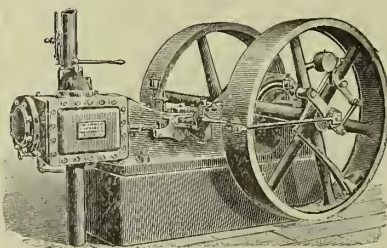
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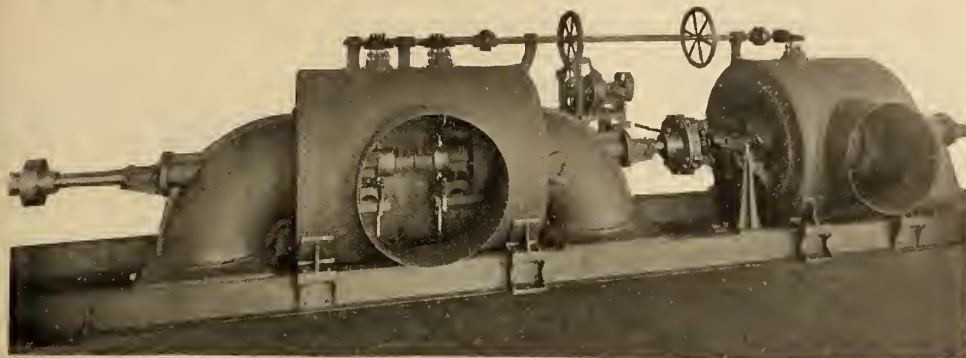
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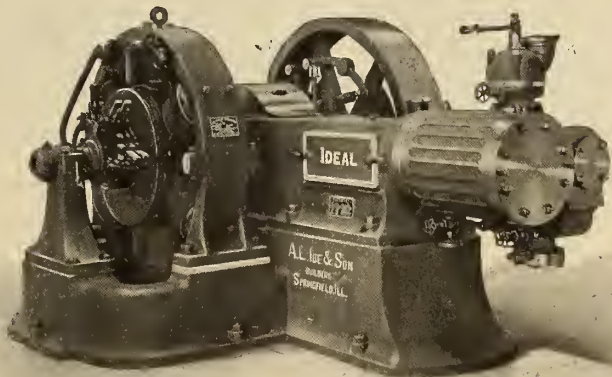
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VOL. VII.

OCTOBER, 1897

No. 10.

**ELECTRICAL POWER TRANSMISSION
PLANT AT THREE RIVERS,
QUEBEC.**

By H. R. LEYDEN.

THE first long distance electrical power transmission plant to be installed in Canada has now been in operation for six months, with most satisfactory results both from engineering and financial standpoints. This plant

power is applied to the old system with surprisingly few changes in the old method of distribution.

The old plant consisted of two single-phase alternators of 1,500 and 750 incandescent lamps capacity, and of two series arc dynamos, one of 35 and the other of 50 lamps capacity. All the dynamos were belted directly to high-speed steam engines. There was also a suitable boiler plant, using bituminous coal for fuel. In connection with the electric lighting plant, there was a pump-



NO. 1—THE WATER FALL.

has been installed by the North Shore Power Company, and transmits power from the water fall at Grande Chute, on the Batiscan river, over a distance of seventeen miles, to the city of Three Rivers. The present development is for 600 horse power delivered at the end of the transmission line, but the plant has been laid out with the view of increasing this largely for future demands. The most interesting feature in connection with this transmission plant is the novel method in which the new two-phase power is applied to an old electric lighting plant, which had previously been in operation, using single-phase alternating apparatus and a series arc system driven by steam power. The new

ing plant having capacity for delivering 1,000,000 gallons every twenty-four hours, which supplied the water service of the city. Both the lighting and the pumping plants were owned by the municipality of Three Rivers, and had been operated by them for over six years. A careful system of accounting has shown, however, that even with higher rates for service than are charged elsewhere by private companies, this municipal plant was running behind every year. The city authorities, therefore, decided to dispose of the plant and stop the continued outlay necessary to supply the yearly deficits in their lighting and pumping account. The plant was accordingly sold to the North Shore Power Company at

a very large reduction from its original cost, and a contract made with that company for supplying the street lighting and pumping service required by the city at rates which are usual in cities of this size and character.

The company, in order to lessen the cost of such service, decided to employ water power, which is quite plentiful in this portion of the province of Quebec. The most available powers were at considerable distances from the city, and the cost of transmission was at first thought to be too great, but a careful investigation went to show that by utilizing the Grande Chute of the Batiscan river the cost of the transmission line would be comparatively small, and that the necessary investment for the hydraulic and electrical plant would pay a very good return.

THE WATER POWER.

This beautiful water fall, a view of which is shown in cut No. 1, was almost ideal for a development of this character; the waters of the Batiscan at this point tumble over rocky ledges, giving a total fall of sixty feet within a distance of 100 yards. The Batiscan river

nearly all the dam work for its utilization had already been done by some volcanic upheaval, so that it only required the expenditure of a little over \$1,000 on masonry work to render the large natural force of this power available in a very convenient form.

A general view of the premises is shown in illustration No. 2. It will be seen that only a short length of stone masonry work was necessary to form the dam and head gate construction. The stone for this work was procured on the spot by blasting away portions of the ledge, and the dam was built directly on the granite rock which formed the crest of the fall. The artificial dam only extends half way across the stream, the other part being a natural spillway over which the waters fall, as shown in view No. 1.

From the head gates the water is conducted in a steel flume down through a natural gully directly underneath the power house, a distance of 400 feet. The flume is 6' 6" in diameter, and is built up in 6' lengths of one-quarter inch boiler plate, supporting foundations being built underneath it every 15 feet. It is the intention to



NO. 2—GENERAL VIEW OF THE PROPERTY AND POWER HOUSE.

always has a large and regular flow of water in all seasons of the year, being fed by large lakes a long distance back in the Laurentian Mountains. The power of the whole fall is estimated at over 3,000 horse power, but only a portion of this is utilized for the present requirements of the plant. In addition to this large and constant flow of water, this fall has the particular advantage of being free from a bug-bear of all water power plants in cold climates—frazil. This is a peculiar ice formation differing both from anchor ice and slush ice, and which is much more dangerous to water wheels and racks than either, for it does not usually float on the surface of the water, especially if the current is swift. It forms only in open water, and in still water will rise to the top, so that the only reliable method of avoiding its dangers is to have a large still body of water above the dam. Immediately above the Grande Chute the water is dead and covered with ice in winter for a mile and a half up stream, so that there is no fear from this source.

This magnificent power seems to have been designed by nature for the purpose to which it is now being put ;

cover the flume before cold weather sets in with spruce boughs, over which the snow covering will make a protective blanket against the intense cold of winter.

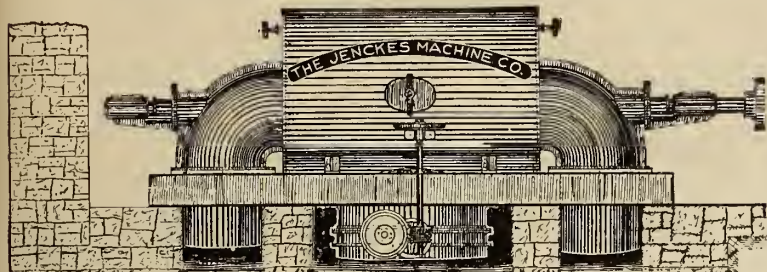
THE POWER HOUSE.

The power house, shown in cut No. 2, is a substantial stone structure, and has for its foundation a flat ledge of granite. It is 62' in length by 36' in width, and is designed in such a way as to allow an increase of the present equipment as the demand for power grows beyond the present wheel installation of 800 horse power.

The lower end of the steel flume is terminated by a large head sheet, which is provided with a gate valve for draining when the water is shut out ; a few feet from the lower end, and directly beneath the wheel cases, the water for supplying the turbine is taken from the feeder or flume by means of two branch pipes, these branch pipes leading vertically upward and connecting with the wheel cases, and being supplied with shut-off gates to clear the turbines of water when required.

The wheel cases stand directly on the floor of the power house on iron girders supported by heavy stone

walls. They are built of 5/16" boiler plate 6' in diameter, with, heavy cast iron heads, terminating in heavy quarter turn elbows 30" in diameter, each of the elbows forming the discharge of one of the turbines, and at the same time providing a bearing for the shaft which runs entirely through the case. The wheels are 20" in diameter, two being mounted on each shaft, and are arranged so that they discharge in opposite directions, equalizing the thrust and giving an even and uniform power on



NO. 3—ONE OF THE WATER WHEELS, IN CASE.

the wheel shaft. Each unit of two 20" wheels gives over 400 horse power under a 50' head, running at 400 revolutions. The turbine shafts are connected directly to the generator shafts, thus doing away with the gearing and forming an ideal way of driving the generators.

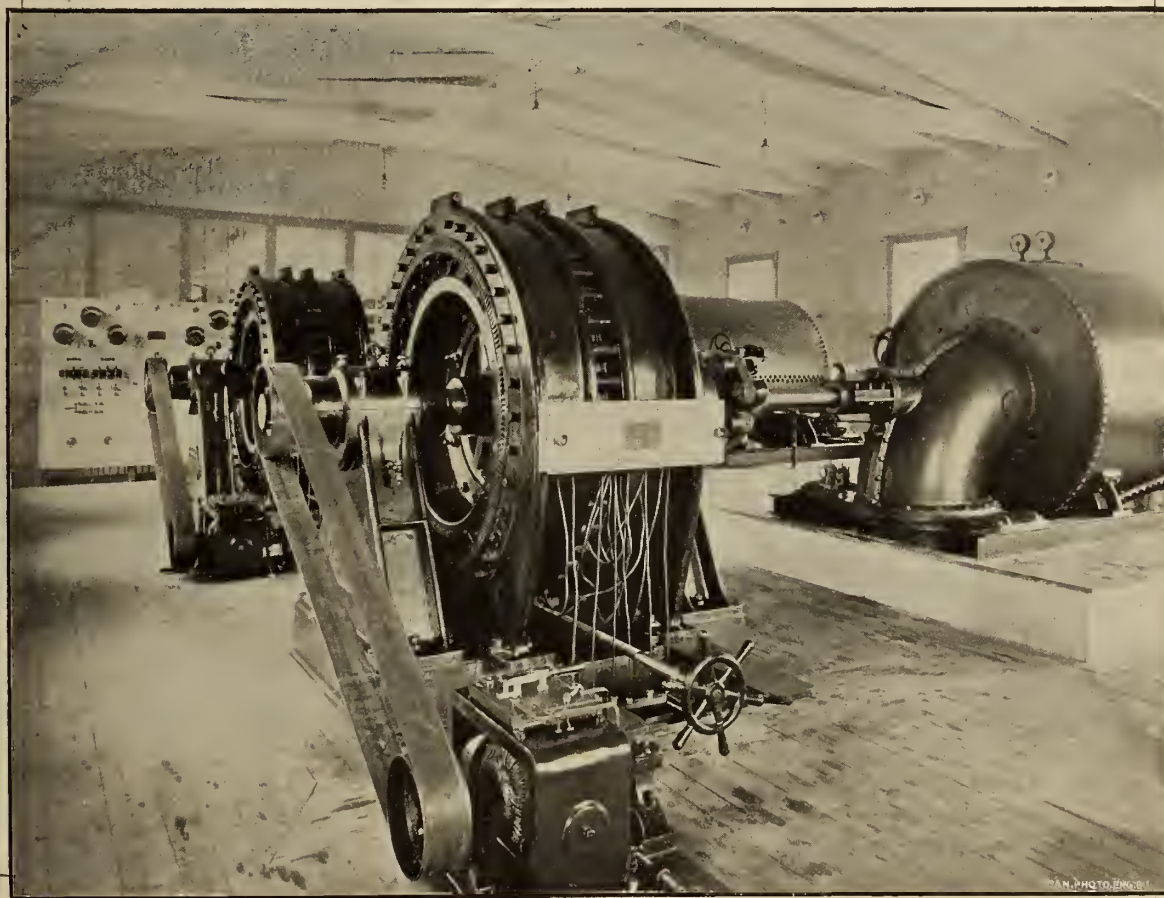
Cut No. 3 gives an illustration of one of the cases, with its arrangement, taken from a drawing prepared

are of the S. K. C. two-phase type, of 240 kilowatts capacity each, and were supplied, together with the rest of the electrical equipment, by the Royal Electric Company, of Montreal. The generators are connected directly to the turbine shaft by means of a flexible insulated coupling. These couplings are made of sole leather links, which connect projecting pins on the generator and turbine halves of the coupling. They have proved extremely satisfactory in service even when the shafts have not been in true alignment. The exciters, of which there is one for each machine, are belted to the other end of the generator shaft.

The current is generated at a pressure of 2,400 volts, and at a frequency of 16,000 alternations per minute. This periodicity was adopted because the electrical distributing apparatus at Three Rivers was designed for this number of alternations, and it was not considered advisable to change it. A neat switchboard of white marble has been installed to properly regulate the generators, which are designed to operate in parallel.

From the switchboard the current is carried to the step-up transformers, where the pressure is raised to 12,000 volts.

These transformers are placed in a separate room,



NO. 4—INTERIOR OF GENERATING PLANT.

for the plant, which will show more fully the compactness of this design. The wheels are of the Crocker type, and they, together with the flume and head gate work, were supplied and installed by the Jenckes Machine Company, of Sherbrooke, Quebec.

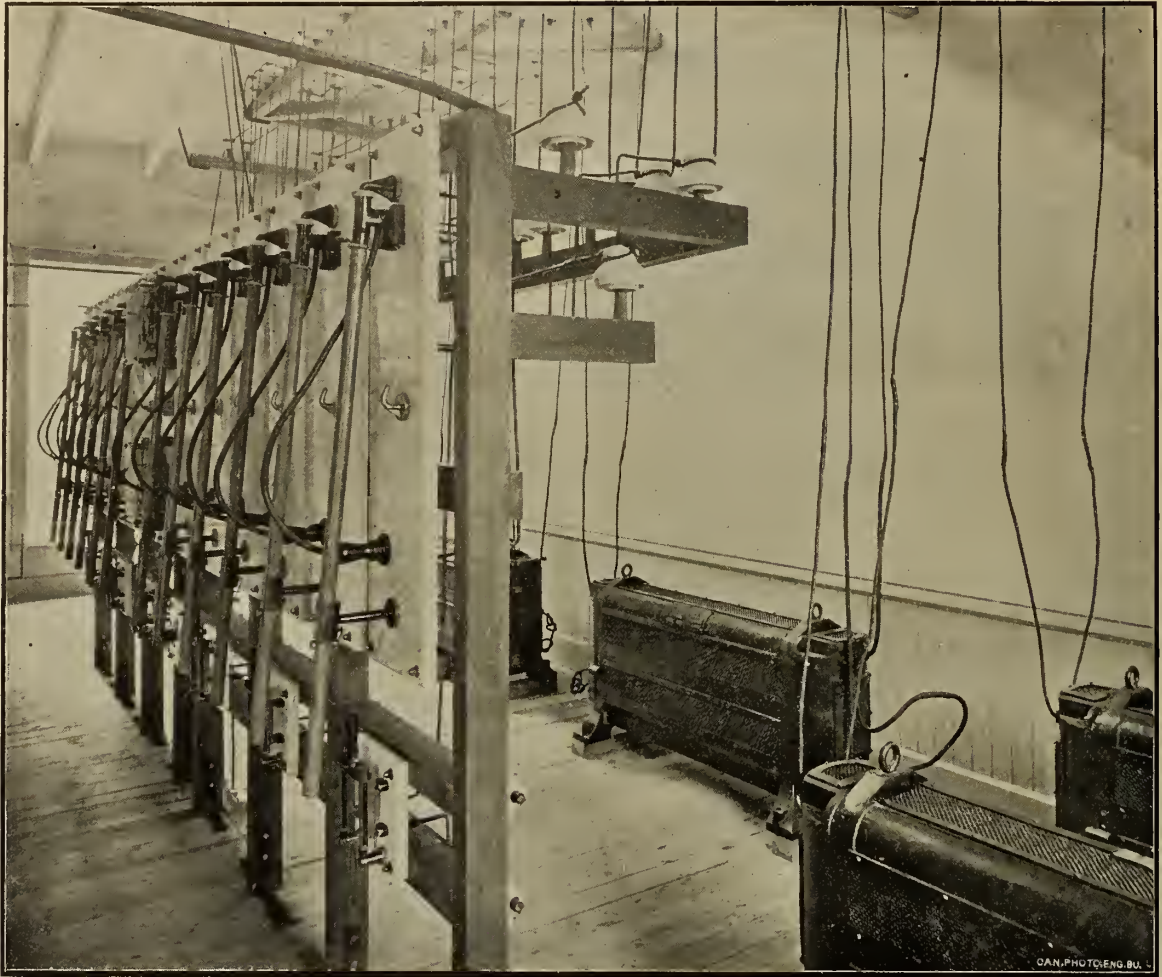
THE GENERATING PLANT.

The interior of the generator plant is shown in cut No. 4. The electric generators, of which there are two,

which is divided from the main room by a glass partition. A view of the step-up transformer room is shown in cut No. 5. The transformers are in 60 kilowatt units, or four for each phase of the plant; they are of the self-cooling type, using neither air-blast or water to keep the temperature down. The primary and secondary coils of each transformer are controlled by separate switches, so that they can be readily thrown in or out of service as required. The switches on the

12,000 volt side are of the S.K.C. non-arcing plug type, as can be seen from the illustration. These switches will break a 12,000 volt arc effectually, with no danger to the operator or the switch, and form a valuable adjunct to the plant. The 2,400 volt switches are of the

Considerable difficulty was experienced in procuring insulators suitable for this work. The requirement was that they should stand a high voltage stress of 40,000 volts for five minutes when placed in a salt water bath, and the hole for the pin also filled with salt



NO. 5—STEP-UP TRANSFORMER ROOM AND HIGH POTENTIAL SWITCHBOARD.

ordinary jack-knife type. On this step-up transformer board there are also placed two static ground detectors; they are for indicating any grounds on the transmission line, and are connected directly to the high pressure wires. From this board the wires are led to the cupola on the roof of the building by means of the porcelain line insulator construction shown in the illustration.

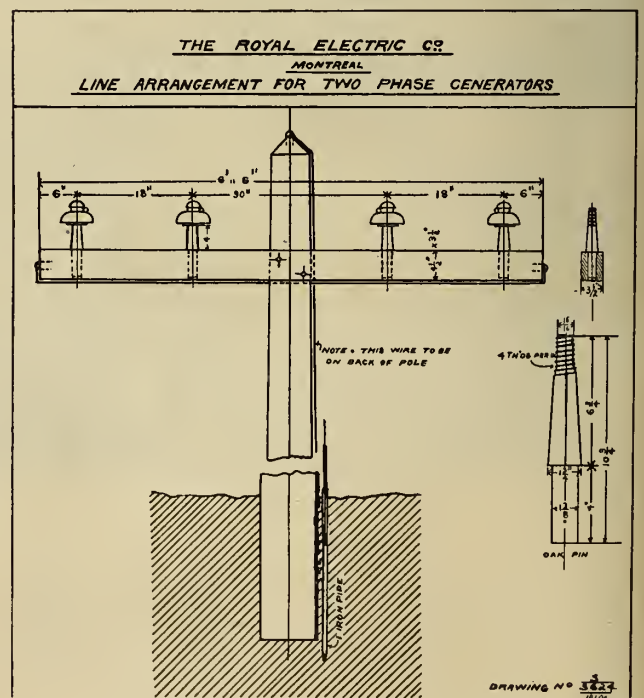
Taking it as a whole, this power house is a model of neatness and compactness for a plant of this kind. The interior is painted white throughout, and presents a clean and cheerful appearance.

From the power house the transmission line leads directly up the side of the mountain, and thence off on almost a straight line to Three Rivers. The country through which it passes is diversified between bush, public highway, farm division lines, and finally along the right of way of the Canadian Pacific Railway, which it follows for the last eight miles.

LINE CONSTRUCTION.

The line construction is shown in cut No. 6. The transmission circuit consists of four bare copper wires, No. 4 B. & S. gauge. This transmits the full power of the two generators over the 17 miles with a total loss of ten per cent., of which a little more than two per cent. is due to induction. The poles used are of white cedar 35' in length and 6" in diameter at the top, set 5' in the earth. The wires are placed 18" apart, and supported on special high voltage porcelain insulators.

water. Of the first lot supplied almost all failed in the test and were not accepted. Another manufacturer,



NO. 6—METHOD OF LINE CONSTRUCTION.

however, supplied insulators of which less than 2% failed under this test.

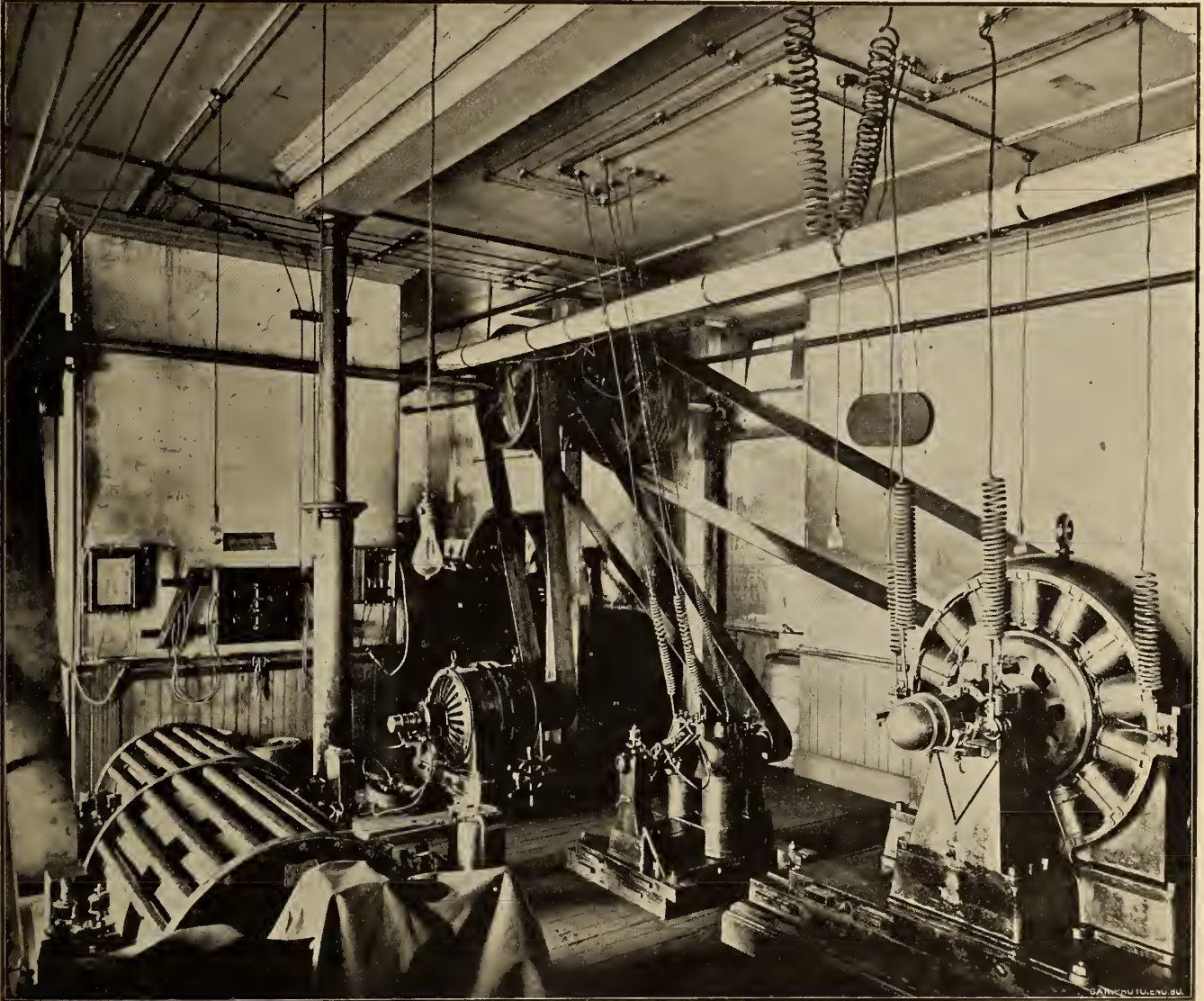
The pins supporting the insulators are made specially

tall to keep the wires free from wet snow, which falls heavily in this region.

This line construction is giving very satisfactory results, the only accident being on the first night of the operation, when a limb of a tree got across the wires, the result being that the limb and the wire were both burned off at that point. Since then there has been no trouble whatever.

On the top of the poles and at each end of the cross arms are fastened lines of ordinary barbed fence wire as a lightning protector. These wires are attached with ordinary staples and grounded at every sixth pole, by means of extending a galvanized iron wire down through an iron pipe planted beside the pole. This lightning protection is supplemented by banks of lightning

the side of the bridge is used. The wires run directly to the old power house at Three Rivers, which is used as a distributing station. Here step-down transformers are used to reduce the pressure to 1,100 volts, which is the voltage formerly employed in the old lighting service. A transformer board similar to the one in the power house at Grand Chute is used to cut in and out each individual transformer. The transformers used for incandescent lighting are made with regulating secondaries, so that the voltage on the lighting circuits can be controlled from here as well as at the generator. The old incandescent circuits were attached just as they were, no change of any character being necessary. The employment of 16,000 alterations in the new plant allows the use of the old transformers, while if a lower



NO. 7—ARRANGEMENT FOR SUPPLYING THE ARC LIGHTING SERVICE.

arresters at each end of the line. This method of lightning protection has proved itself thoroughly efficient during the past summer, in which time there occurred numerous electric storms without producing any trouble.

A telephone line, which is not shown in the cut, was afterwards strung by using ordinary galvanized iron wire attached to side brackets below the cross arms. Ericson's anti-induction instruments are used and no annoying hum is experienced. The ordinary solenoid instruments, which were first installed, did not operate well when the line was heavily loaded.

The line crosses the St. Maurice river on the highway bridge just outside of the city of Three Rivers; here the ordinary cross-arm construction built out from

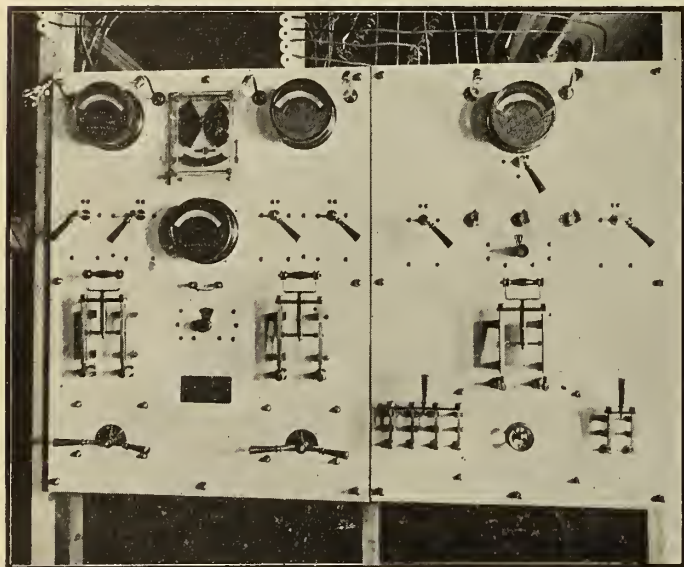
frequency had been employed, it would have been necessary to change them for new ones designed for the lower periodicity. The incandescent service is much improved since it has been operated in this manner instead of by means of the old steam plant.

THE ARC LIGHTING SYSTEM AND SYNCHRONOUS MOTOR.

Cut No. 7 shows the arrangement for supplying the arc lighting service. This was formerly supplied by two Royal arc dynamos, shown to the left of the illustration, belted direct to the engine pulleys. The new arrangement is to use the old 1,500 light single phase alternator as a synchronous motor operating from one phase of the two phase circuit to drive the arc machines instead of the engine, the other parts of the arc sys-

tem, switchboard, connections, circuits and lamps remaining the same. The dynamos were not even moved from their former position, so that in case of accident to the water power the old belts can be put on and the plant operated by the steam engines as before. All that was required to accomplish this change was to place a shaft overhead to which all machines are belted, and to install a 10 horse power induction motor to bring the old alternator into synchronism with the generators at the power house. Clutch pulleys are used for driving the arc machines, so that the starting motor has only to start the synchronous motor and the shaft. When the synchronous motor is brought to speed, the current is thrown on and it immediately takes the load and the starting motor is shut down; the arc dynamos are then thrown into service with the clutch pulleys and the arc lamps operated in an entirely satisfactory manner. This is another reason for employing 16,000 alternations, for, if a lower periodicity had been employed, the old alternator being a 16,000 alternations machine, could not have been used for this purpose.

It is found that 60 kilowatts delivered from one phase



NO. 8—SWITCHBOARD IN DISTRIBUTING STATION.

of the generator will supply all the loss in transmission, the losses in the motor, shafting and arc machines, and operate 781,200 candle power lamps, with their circuits, which are about four miles in length. The simplicity and economy of this method of operating an old plant is strongly in favor of the flexibility of the two phase system for transmission work.

SWITCHBOARD AT DISTRIBUTING STATION.

Cut No. 8 shows the switchboard used at the distributing station. It is composed of two panels of white marble, having the instruments mounted directly on the slab; the right hand panel is for the synchronous motor. The ampere meter at the top is provided with a short-circuiting switch, so that it can be cut out when the plant is in operation; it is only used for the purpose of properly adjusting the field of the synchronous motor, so that it takes the least amount of current; that is, it is neither over nor under excited, so as to produce leading or lagging currents. Below the ampere meter is a synchronizer of the ordinary three lamp type, and on either side are seen the handles of duplex fuse blocks, which are on the back of the board; they are provided with two fuses each, so that if one should blow, by throwing this handle the other is immediately

thrown into service. Below are shown the main switch, the field switch and exciter rheostat, and the four pole two phase starting motor switch. The left hand panel shows the incandescent distributing board; it is for two circuits, such being the old distribution. Each circuit is provided with an ampere meter, two fuse blocks, main switch and transformer regulator head. In addition, there is an "S.K.C." static ground detector and a voltmeter, each capable of being thrown on either circuit by means of a changing switch.

PUMPING PLANT.

The pumping, which is done in the same building, was formerly performed by a duplex steam pump. This plant is now being replaced by two triplex double acting power pumps, each driven by a two phase motor; one of these pumps will be sufficiently large for the ordinary service, but the second will be started in case of fire or extra calls upon the plant. The water will be pumped directly into the mains, no reservoir or gravity pressure being employed. In order to utilize the constant speed of the motors, the discharge pipes of the pumps will be provided with relief valves, so that whenever the pressure in the mains exceeds the prescribed limit, the extra water will run back to the suction pipes through the relief valve.

This simple arrangement will enable the company to perform all the lighting and pumping service of the city by means of the water power seventeen miles distant and to close down the steam plant entirely. The steam plant, however, will still be retained as an emergency plant in case any accident should interrupt the water power service.

The changes above described have been accomplished with no interruption of the old service, and have utilized all the electrical apparatus except the 750 light alternator, which is now not required. No money whatever has been required for changing the distributing system in order to accommodate it to the two phase current transmitted from the water power, and in accomplishing this the arc and incandescent services have both been very greatly improved.

ELECTRIC VS. STEAM RAILWAYS.

STEAM railways have now to reckon with the competition offered by electric roads for local passenger traffic in the vicinity of cities. The only way in which the steam roads can hope to retain a fair share of this traffic is by meeting the low rates offered by the electric roads. We are told that the Grand Trunk Railway Company lost a valuable passenger business between Hamilton and Burlington, by refusing to meet the wishes of the people in the matter of a reduction of rates. In consequence of this refusal, the people who had been accustomed to travel on the steam road transferred themselves to the Burlington Electric Railway Company's cars. When the Grand Trunk people saw their traffic slipping away from them, they announced a reduction in rates to the figure which they had previously refused to grant. Their offer came too late, however. They had antagonized their customers, who, having found the electric road cheaper and more convenient, refused to come back. As a result the G.T.R. trains are running light and the electric road is doing a rattling trade.

The Jenckes Machine Co., of Sherbrooke, shipped last week a complete tramway plant to the Lucky Jim Mines, at Sandon, B.C.

THE STEAM ENGINE INDICATOR.*

By G. B. RISLER.

The indicator is an indispensable assistant to the engineer, and of late years it has become evident that intelligent and wide-awake steam plant owners recognize the necessity for such a valuable instrument, and they are also appreciating the services of the engineer who is competent to use it properly.

The indicator diagram is actually the only means of showing on paper what really takes place in a cylinder. To read an indicator card correctly is not an easy matter, and in order to be able to do so, considerable study and practice are necessary. The handling of such a delicate instrument requires a great deal of care, and sometimes considerable skill and ingenuity must be employed in making the needed attachments. By its use many stumbling-blocks will be removed, while the calculations and geometrical work which the engineer will be impelled to make in connection with it will lead to the acquisition of a good, general knowledge of the whole subject. Careful consideration of the diagrams from different engines, under varied conditions, cannot fail to lead to thought and investigation. A general knowledge of the law of gases (especially Mariotte's law) is needed, and a study of physics, mensuration and mechanics is most beneficial.

In order to determine the most economical plan of operating a steam plant, many tests are made. Such tests if properly conducted are valuable, and are much to be appreciated by steam plant owners, who will find it to their interest to give every encouragement and assistance to the engineer along this line. The diagrams traced by the indicator pencil will vary widely, and depend on the condition of the different engines from which they are taken, and it therefore becomes necessary to know how to interpret these variations correctly. This information the engineer can only acquire through the processes of reasoning and hard study. In attaching the indicator considerable skill is sometimes needed, and circumstances must determine what plan can best be employed. The reducing motion must be such that it will give to the paper barrel in its reduced scale an exact reproduction of the movement of the piston.

Examine your indicator and see that every part of it is moving freely, has no lost motion, and is well oiled. A cord that will stretch is to be avoided. Good judgment is required in putting the proper tension on the paper barrel spring for differently speeded engines. The indicator springs should be tested occasionally to see if they agree with a standard steam gauge of known accuracy. Do not use too light a spring for the pressure. If the instrument is a reliable one, and the necessary precautions have been taken in every particular, the diagram will then show you the pressure acting on the piston on both sides, and at any part of the stroke during one revolution of the engine, and that is all it will do. Knowing the scale of the spring, it is an easy matter to determine the pressure at any point of the stroke. This little tell-tale instrument will leave on a piece of paper a good deal of information, providing the atmospheric pressure line is properly established on the diagram. It is of the greatest importance that this line be drawn correctly, as it is the neutral line of the diagram, and from it all pressures above and below must be determined. After removing the card from the paper barrel it is advisable that all data be made on it as complete as possible, and then will its study be pleasant and profitable.

The following terms are used in speaking of the different lines and curves: The atmospheric line, vacuum line, admission line, steam line, exhaust line, counter pressure line, compression and expansion curve. The beginning and termination of some of these lines are called points, and their continuation indicates periods in the stroke of the piston. Technical terms for pressure are as follows: Boiler pressure, absolute pressure, initial pressure, cut-off pressure, terminal pressure, back pressure, and mean effective pressure. The mean effective pressure is what we must find in order to calculate the indicated horse power of the engine, and the indicator card is the only means of getting it correctly.

Having once established the mean effective pressure from the diagram, the work done in one stroke, in foot pounds, can be calculated as follows: Multiply 144 by the mean effective pressure, and by the cylinder volume in cubic feet, displaced by the piston. Two simple and easily remembered rules for finding the indicated horse power when the mean effective pressure is known, are as follows: 1. Multiply the mean effective pressure by the cylinder area in square inches and by the piston speed in feet per minute, and divide by 33,000. 2. Multiply the mean effective pressure by the length of the stroke in feet, by the area of the cylinder in square inches, and the number of strokes per minute, and this, divided by 33,000, will equal the indicated horse power. From the foregoing it can easily be seen that the indicator is invaluable in determining the work done by an engine.

But this is not all, by any means. An analysis of the expansion curve, which requires considerable knowledge and accurate working from a geometrical and arithmetical standpoint, is of great value, and the

nearer the actual expansion curve of the diagram approaches the theoretical (often called the equilateral hyperbola) the greater will be the economy. A considerable deviation from the actual and the hyperbolic curve impels the engineer to think and to reason out the cause. A leaky piston, a leaky steam valve, re-evaporation in a cylinder, or a leaky exhaust valve—all these tend to bring about an expansion curve, which is not in accordance with the law of gases laid down by Mariotte, viz., that the volume should vary inversely as the pressure. This, of course, is to some extent an impossibility in an engine cylinder, owing to loss of heat and leakage. Nevertheless, diagrams have been taken from steam engines which are a credit to the engineer, as well as to the engine builder, and are almost identical in the expansion curve to the hyperbola. It is not advisable to come to hasty conclusions in regard to the expansion and compression curve, as well as other lines, because the laws of nature can have quite an influence in this respect, owing to the surroundings and conditions under which a steam engine may be working. The engineer well knows that dry steam should be furnished to an engine; therefore, it is reasonable to state that the steam boiler at times can be held responsible for a diagram which does not approach the ideal. If the steam pipe leading to the boiler is too small in diameter, the indicator diagram will give an indication of it, but this should be verified with the diagrams taken direct from the steam chest or the steam pipe. The indicator card will furnish the means of knowing how the steam is distributed in the cylinder. If the valve gear is not properly working the card will show it. With calculations from the diagram we can find with what sort of economy, mechanically and thermodynamically, the engine is working, and if underloaded or overloaded the engineer will be in a position to advise his employer exactly what changes should be made in order to insure greater economy in fuel. The steam line may show considerable initial expansion or loss of boiler pressure, and the back pressure line can point out excessive resistance to the piston. Both cases are evidence of wasteful expenditure of steam.

Economy, to the engineer, means keeping down the fuel account, having small bills for repairs, little or no loss from shut-downs, regular speed, and the least possible loss from deterioration. The engineer must be guided by circumstances, and if he finds himself confronted with conditions that render the attaining of strict economy impossible, he then can only make the best of bad surroundings. Steam engine economy is made up of many factors, and it is to be hoped that the endless study and exertion on the part of the intelligent and ambitious engineer will be appreciated by the employer.

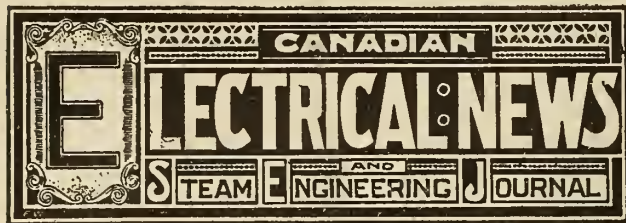
It is my belief that many steam plant owners or managers are willing to assist the engineer financially in obtaining such an instrument as the indicator, as well as other most valuable appliances, which would serve as aids in many instances to the greatest economy.

My employers, The Advertiser Printing and Publishing Company, of London, have recognized the wisdom of this, and assisted me to the extent of \$50 in purchasing an indicator in 1893, and also obtaining for me in 1896 a free engineer's scholarship with the International Correspondence Schools, in Scranton, Pa.

RECENT CANADIAN PATENTS.

PATENTS have recently been granted in Canada for the following electrical and steam engineering devices: No. 56,453, electric railway, Harry C. Reagen, jr., Philadelphia, Pa.; No. 56,457, steam boiler, Edward J. Cusack, Havelock, N. B.; No. 56,464, steam engine, Johan Burchardt Opsahl, Toronto; No. 56,501, electric furnace, John Joyce, Andover, and James A. Denter, Boston, Mass.; No. 56,504, ore reducing electrical machine, Charles P. Tatro, Seattle, Wash.; No. 56,578, application of telephone to electric bell systems, Frederick Hodgson, Hampstead, and George A. Edwards, Peckham, Surrey, England; No. 56,580, governor for waterwheels, Marcus P. Schenck, Springfield, Mass.; No. 56,632, governor for steam engines, E. B. Thornburn, Highstown, New Jersey; No. 56,649, rotary engine, David Morgan, Launceston, Tasmania; No. 56,653, feed-water heater and condenser, James M. Keller, Denver, Col.; No. 56,660, electrode for storage or secondary batteries, Paul Ferdinand Ribbe, Lessingstrasse, Prussia, Germany; No. 56,662, storage battery, Albrecht Heil, Frankisch, Crumbach, Germany; No. 56,683, steam boiler, Edward Makin, Manchester, Eng.; No. 56,684, steam generator, Edward Makin, Manchester, Eng.; No. 56,759, dynamo electric machine, Wm. M. Morday, Loughborough, Eng.; No. 56,760, safety device for electric circuits, Lewis G. Rowland, Camden, N.J.; No. 56,761, telegraph or telephone cable and their connections, James M. Barr and C. E. S. Phillips, Castle House, Kent, Eng.; No. 56,782, switchboard annunciator, Bell Telephone Company, Montreal; No. 56,794, steam generator, David M. Thompson, Providence, R.I.; No. 56,798, steam indicator, Karl Mastard and Wilhelm Beerensson, Berlin, Prussia, Germany; No. 56,806, rotary engine, Eber B. Tree, Woodstock, and Robert H. Eldon, Toronto; No. 56,808, telephone toll apparatus, Siegfried Silberberg, New York, N.Y.; No. 56,809, toll apparatus for meters, Siegfried Silberberg, New York, N.Y.

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Use of the Incandescent Lamp.

We have been watching with interest the growing use of incandescent lamps for decorative and advertising purposes.

During the recent jubilee celebration in Toronto some of the principal business and public buildings were handsomely decorated with incandescent lamps arranged in a variety of forms and in rich and harmonious colors. During the evenings when these illuminations were on view the streets were thronged with people till midnight. By the use of the incandescent electric lamp the windows of many large stores have been rendered even more attractive at night than in the day time. Electrically illuminated street signs are a conspicuous feature of the streets of New York at night, while an immense globe of blazing incandescent lamps surmounts the dome of one of the largest buildings on Broadway, and is a conspicuous object for miles around. There is large room for development in Canada in the use of electricity for such purposes as those mentioned, and wide-awake electric light managers and business men will find it to their profit to cultivate this field.

Municipalities and Street Railways.

WHEN public franchises are to be disposed of it is reasonable to expect that municipal authorities will endeavor to make the best bargain possible, and to receive the greatest remuneration for the privilege granted. It is just possible, however, that the conditions exacted in some cases may be of such a nature as to operate against the interests both of the municipality and the company securing the franchise. As an instance of this we may point to the street railway in the city of Hamilton. There, according to agreement, the street railway company has been compelled to pay to the city six per cent. of the gross earnings, besides a certain mileage charge. The company found themselves unable to do this, and a few months ago the city council passed an amended relief by-law, but it is said to have been so

loaded down with conditions that the company refused to accept it. The possession of a street railway franchise in the city of Hamilton is not likely to prove very remunerative to any company, and more especially under unfavorable conditions. It would seem to have been in the interest of the city to have given such concessions as would permit the company to pay a reasonable dividend to its shareholders, and improve the efficiency of its system. Being crowded financially, this became an impossibility. There is said to be a movement in favor of the city taking over the railway. Should this be decided upon the operation of the road will be watched with much interest.

Electric or Hydraulic Elevators.

THE new municipal buildings at Toronto are about to be equipped with elevators, for which tenders have been invited, and the question has arisen as to the comparative cost of operating and maintaining hydraulic and electric power machines. The first cost is greatly in favor of the electric elevator, while the architect has also recommended its adoption. The chief argument in favor of the hydraulic system is that when the heating plant in the building is in operation, the extra cost of fuel consumed to generate high pressure steam to supply power to operate the pumping plant is very small. It is further claimed that the exhaust steam from the pumping plant can be used to heat the building, thus lessening the cost of heating. Notwithstanding this, figures obtained by the architect of the comparative cost of operating the two classes of elevators in the principal buildings in Toronto show the average cost per day of electric elevators to be 58 cents, against 96¼ cents for hydraulic elevators. From this it would appear that under ordinary conditions electric power for elevator purposes is the more economical, but in many cases the choice of elevator will no doubt be determined by special conditions and surroundings.

Prospects For Foreign Business.

IT is most gratifying to observe that Canadian machinery manufacturers are securing a foot-hold in foreign countries, and that our goods are regarded as equal to those of any other manufacture. In electrical and steam engineering apparatus the outlook is fully as favorable as in other lines. On another page reference is made to a franchise secured by Mr. Chapman, of Montreal, for an electric railway in Jamaica, much of the machinery for which will, it is said, be supplied by Canadian manufacturers. It will be remembered that Mr. William Rutherford, formerly chief engineer of the Canadian General Electric Company, left last spring to accept the management of the electric traction department of the English engineering firm of Dick, Kerr & Company. Mr. Rutherford has recently been on a visit to America, and while here placed a contract with the Robb Engineering Company, of Amherst, Nova Scotia, for several high speed engines for electric tramway service at Barcelona and Madrid, Spain. He also placed contracts with the General Electric Company, of New York, and the Allis Company, of Milwaukee, for electrical machinery and engines to the value of one hundred and sixty thousand pounds. It is said that the prospects for European trade in electrical machinery are favorable, and the above facts would seem to verify the statement. Canadian manufacturers are certain to receive their share of the trade.

Electrical Cooking and Heating.

A COMPARATIVELY new field for the employment of electricity is its application for heating and cooking purposes. For the former purpose it has already been used in Canada to some extent, but electrical cooking is of more recent origin. Two Canadian manufacturing companies have lately placed on the market lines of apparatus for cooking and heating by means of the electric current, an exhibit of which was made last month at the inauguration of the Lachine Rapids Hydraulic and Land Company's plant at Montreal. In a paper read by Mr. J. P. Jackson before the American Institute of Electrical Engineers, some figures are given of the relative cost of cooking by means of electricity and coal as the source of energy, the results being determined by actual experiments. The cost of cooking three meals by the electric current was found to be 13.1 cents per meal, and the cost by coal 3.15 cents per meal. The energy required for four hours' ironing was produced by electricity at a cost of 22.7 cents, and by coal at 12.25 cents. The results of these tests would seem to indicate that for the ordinary cooking of a family electricity is yet too expensive to become very generally adopted, but there are many advantages in its use, such as cleanliness, decreased fire risk, convenience, etc., which will undoubtedly cause it to be employed by those who value these considerations above the single item of cost. It is also possible that with the more general adoption of electricity it may be in the interest of central stations to reduce the price charged, especially for day load service. There appears to be a growing recognition by central station managers that every possible means should be employed of increasing the day load, and electrical heating and cooking will provide a means of doing this.

CANADIAN ELECTRICAL ASSOCIATION.

THE Executive of the above Association, encouraged by the success of the convention at Niagara Falls in June last, are taking time by the forelock as regards the preparations for the convention to be held in Montreal next year.

At a meeting of the Executive Committee held recently, Messrs. C. B. Hunt, A. M. Bowman, A. A. Dion, J. J. Wright, A. M. Wickens, W. H. Browne and the Secretary were appointed a committee to procure suitable papers.

The following persons were appointed a committee to endeavor to extend the membership of the Association: Messrs. F. C. Armstrong, J. A. Kammerer, K. J. Dunston, A. A. Dion, O. Higman, F. H. Badger, E. E. Carey, and the Secretary.

A committee on arrangements was appointed as follows: Messrs. Wm. Thompson, W. H. Browne, John Carroll, L. B. McFarlane, J. A. Baylis, F. H. Badger and O. Higman.

It is gratifying to see this evidence of the determination of the Executive to complete as early as possible arrangements which will tend to ensure the success of the Montreal meeting.

The Association is actively engaged in other directions also in behalf of the electrical interests, and is receiving the hearty co-operation of many of the electrical companies. Those companies which have as yet failed to reply to the circular recently issued by the Association, should do so without further delay, and fall into line with those who have already promised co-operation with the work which the Association has in hand.



LACHINE RAPIDS HYDRAULIC & LAND COMPANY—A WINTER VIEW OF THE UNCOMPLETED POWER HOUSE.

INAUGURATION OF THE LACHINE RAPIDS HYDRAULIC AND LAND COMPANY'S POWER PLANT.

THE inauguration of this company's new hydraulic and electric plant at Montreal took place on Saturday, September 25th, under favorable weather conditions. The directors issued nearly three thousand invitations to prominent persons in Montreal and elsewhere, and the company's magnificent power house, nearly one thousand feet long, was crowded with visitors. Letters of regret were read from Sir Wilfred Laurier, Hon. Messrs. Marchand and Robidoux, Sir Adolphe Chapleau, Hon. W. S. Fielding, Hon. A. G. Blair and others.

Those who, previous to the construction of these works, had been acquainted with the general appearance of the Lachine rapids at point of utilization, were pleased to observe that the carrying out of such an immense industrial enterprise had not in any way marred the beauty of the rapids. The neat appearance of the power house, both externally and internally, was freely commented upon.

Promptly at 2 p. m. the president of the company, Mr. G. B. Burland, received the guests in No. 1 power house, and read an interesting address, which in part will be found below.

PRESIDENT'S ADDRESS.

A little over twelve months ago, said Mr. Burland, I stood almost upon this same spot, and made certain statements and promises to those present; to-day, in the name of the directors of the Lachine Rapids Hydraulic and Land Company, I invite you to witness how these statements have been fulfilled and the promises carried out. I told you that we would divert the river from its course, and excavate its bed; that we would build a wing dam a mile long and a cross dam 1000 feet long; that we would then restore the river to its place; that instead of a roaring torrent we would show you a still basin in which would be locked up a force equal to 8,000 horse power. I ask you now to look around and see whether we have accomplished all this. We have accomplished more; we have here a power which registers not only 8,000, but 21,000 horse power.

I will not detain you with any details of construction. You see results, which speak more strongly to you than any mere statement of mine: The 300,000 yards of rock removed; the millions of feet of lumber in our dam; the thousands of yards of cut stone and concrete; the tons of steel, and the thousands of men employed, and all this has been accomplished without a single loss of life or serious accident of any kind; without any outside financial assistance; without any excess of expenditure over estimates; without any payments for extras, and without any mistakes either in calculations or construction.

I will not detain you longer to discuss such myths as back water, frazil and ice pressure. The best proof that we believe they are myths is that fourteen (14) of our subscribers were found willing to invest \$1,400,000 of their own hard-earned cash in the enterprise. Our temporary works have been here over a year, and we experienced no trouble from ice pressure; we saw nothing of back water, and we did not find enough frazil to stop up the leaks in our temporary dams.

Our capital in the first instance was \$1,000,000. That amount our engineers deemed sufficient to acquire rights, to construct head and tail races, power house, and install 66 water wheels,

with the necessary gearing and jack shaft. How far they have succeeded in their estimate you may gather from the fact that since the commencement we have increased the number of wheels from 66 to 72. We have deepened 1,200 feet of the river bed below the main dam, removing an immense reef of rock, which was the great stumbling block to all who went before us. We have constructed a system of booms and guard piers in our head race. We have extended the length of our power house over 120 feet, and notwithstanding this, when all our work is completed as you see it to-day, we are still \$25,000 under our original estimates, a fact in itself which crowns the ability of our engineers.

The engineers' estimate of the power produced under the first contract was about 8,000 horse power. To-day they have provided for installing 72 wheels, each of which is capable of giving, under a thirteen foot head, 300 horse power, or a total of twenty-one thousand six hundred (21,600) horse power, and the head on our wheels is to-day (if any one of you here present have a doubting spirit and a tape measure or rule, you may satisfy your own curiosity) between fifteen and sixteen feet, which will yield much more power than that already given.

Now, it stands to reason that if it was estimated to cost \$1,000,000 to complete the hydraulic installation and to supply power on the jack shaft, the same power could not be converted into electricity without an increase of capital. It was for this purpose that the capital of the company was increased from \$1,000,000 to \$2,000,000. We have in reserve, therefore, for our electrical transmission and distribution over \$900,000, which, in our opinion, will be ample to provide a transmission and distribution system to market the whole of our power. Already we have constructed an underground system in Montreal, which, in itself, we look upon as a step in advance and in the right direction, that will, we hope, rid our streets of the unsightly poles, and rid our firemen of the difficulty of fighting fires through a network of wires. Eighty miles of underground conduit have already been laid, including cables crossing the canal, and a sub-station has been erected, situated on the corner of McCord and Seminary streets, in the city of Montreal.

Our transmission line, starting from this power house to the Curran bridge on Wellington street, has been constructed in the most permanent manner, of latticed iron poles embedded in concrete, sufficient to stand any strain on the wires during the heavy winds and sleet storms of winter.

Cooking by electricity is also making progress. The ladies will be interested in seeing the tea and coffee made by the current from the rapids to-day. Already broilers, chafing dishes, coffee pots, five o'clock tea kettles, hot water urns, smoothing irons and curling tongs can be obtained from any electrical supply dealer, and it will be the aim and object of this company to supply current at a rate which will allow of their more extended use. We will very soon be prepared to install a separate meter to measure the current used in cooking, and furnish the same at a still greater reduction.

The accomplishment of this great project and the economy of its construction is ample evidence of the skill and ingenuity of our engineers, and the capability of our contractors, Messrs. Davis & Sons, with others engaged in the work, who have in no small degree assisted in the satisfactory and wonderful result you now see before you.

At the invitation of President Burland, R. Wilson Smith, Esq., mayor of Montreal, turned the water on six of the wheels and started the machinery in motion. Mrs. Burland closed the switch, completing the circuit between the Lachine Rapids and the City of Montreal.

The building is an immense structure, nearly 1,000 feet long by 50 feet wide, running directly across the river. The superstructure rests upon huge cut stone

piers, resting upon the bed rock of the St. Lawrence, and laid in Portland cement. At the shore end of the superstructure is a square brick tower, used as offices for the staff, and equally distant are three square brick buildings with slate floors, which will contain the generators and switch-boards. The wheels are so arranged that they are in parallel rows the entire length of the building.

The head race or dam is 4,000 feet long by 1,000 feet wide, with an average depth of 13 feet, making a beautiful stretch of perfectly smooth water running parallel with the shore.

THE HYDRAULIC MACHINERY.

The hydraulic installation, when complete, will consist of seventy-two 57 inch Victor wheels with cylindrical gates, connected up in twelve series of six each by means of mortise bevelled gearing and horizontal shafting directly connected to the generators.

The wheels are governed by an improved governor, known as the Gesler, which is supposed to operate instantaneously the gates of the wheels. The flumes, 36 in number, in which the wheels are placed, are 20 feet wide by 40 feet long, and contain two wheels in each. Forty-eight of the wheels are already installed and twenty-four of them connected to generators. Each wheel is capable of giving 300 horse power under a 13 foot head, so that when installation is complete the hydraulic machinery will be capable of generating 21,000 horse power.

THE ELECTRICAL MACHINERY.

The electrical installation, when complete, will consist of twelve 750 k. w., three phase generators, made by the Canadian General Electric Company, each direct connected to six water wheels and operating at 4,400 volts at 175 revolutions. The generators are of the revolving field type, and each have separate belt driven exciters. Four of these generators are already installed

with common buss bars, the centre panel being devoted to the exciters and containing ammeter, volt meter, switches, rheostats and pilot lamps, while on the other side are the panels of the main generators or alternators, which contain high tension, quick breaking switchers, high pressure volt meters, ammeters and synchronizing lamps.

A magnificent repast was provided by the directors. At 5 o'clock the guests again assembled in power house No 1 to listen to congratulatory addresses by



ONE OF THE 750 K.W. C.G.E. 4,400 VOLT DYNAMOS.

His Worship, Mayor Wilson Smith, Hon. Thomas Duffy, Hon. J. I. Tarte, Ald. Prefontaine, M.P., Sir Jas. Grant, Hon. L. Beaubien, Hon. J. D. Rolland, John Crawford, Esq., and John Morrison, Esq., all of whom spoke in terms of highest praise, congratulating the engineers, Messrs. Walbank and Pringle, upon the successful achievement of their plans.

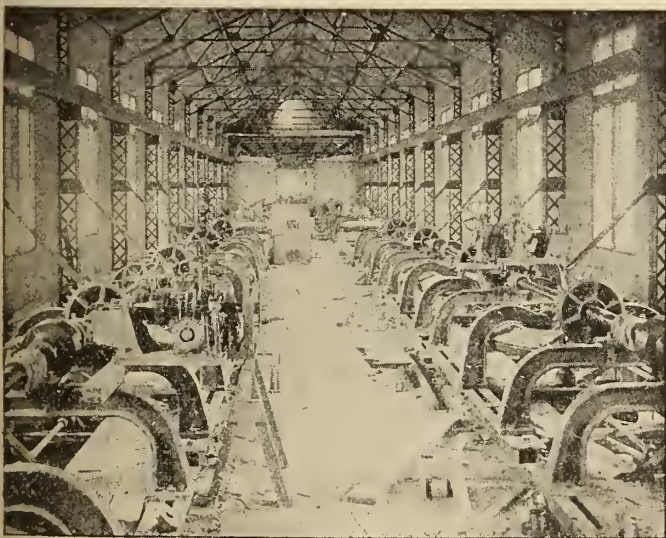
ELECTRICAL COOKING AND HEATING APPARATUS.

One of the most interesting features of the proceedings was the display of electrical cooking and heating apparatus. The Canadian General Electric Company's exhibit included three-phase induction motors, varying from thirty horse power to five, and a complete electrical kitchen, with range, pots, hot water urns, radiators, ventilators, chafing dishes, etc.; in fact, it fairly represented the utility of the electric current in the factory, the parlor, the kitchen, the dressing room, and even the invalid's boudoir.

The Dominion Electric Heating and Supply Company, of Ottawa, exhibited an excellent selection of heating and cooking apparatus, all made under Canadian patents and constructed in Ottawa.

The W. A. Johnston Company, of Toronto, showed Wagner transformers, long burning arc lamps, a single phase self-starting motor, and induction ceiling fan.

Mr. Kingsbury, an electrical engineer of Sydney, Australia, was a visitor to Canada during the past month, studying the developments in electrical science. Mr. Kingsbury was delighted with the evidences of Canada's progress in electrical engineering, a matter in which Australia is as yet comparatively young. He was impressed with the utility and general character of the Canadian street railway systems, and considers that a large business might be secured in Australia by Canadian manufacturers of electrical apparatus.



LOOKING DOWN THE POWER HOUSE FROM THE CENTRE.

and in operation, and four more are in course of erection.

Both the hydraulic and electrical machinery are evidently substantial and constructed with the greatest care, and so arranged that cost of attendance during operation will be reduced to a minimum.

THE SWITCHBOARD.

The switchboard is situated in the down stream end of the dynamo house, and at present has four panels,

THE LATE MR. F. B. ROBB.

THE particulars of the sad death of Mr. F. B. Robb, of Amherst, N. S., are already known to readers of this journal. Deceased was secretary-treasurer and manager of the Robb Engineering Co., Limited, and was drowned while bathing at Fox Harbor, N. S., on July 20th. He was born at Amherst, Nova Scotia, on the 8th of November, 1857. His father, the late Alexander Robb, was one of the pioneer manufacturers of Nova Scotia, having established in 1848 the business which has since developed into the Robb Engineering Company.

The subject of our sketch received his education at Cumberland County Academy and Dalhousie College, Halifax, afterwards being especially fitted for his work by a short experience in banking and commercial college course at St. John. In 1876, when only 19 years of age, he, with his brother, D. W. Robb, now president and engineer of the company, took the full management of the extensive business in which he labored up to the time of his death.

Mr. Robb's strongest characteristic was unceasing industry both of body and mind. Having a love of work, and being gifted with quick perception and methodical habits, he was able rapidly to master every detail of his work, and has been largely instrumental in building up the Robb Engineering Company's busi-



THE LATE MR. F. B. ROBB.

ness, which has during the past few years extended to all parts of Canada.

The late Mr. Robb had a very sympathetic nature, and early in life was impressed by deep religious feeling, which prompted him to take a prominent part in the work of every religious and charitable organization that came in his way. There are probably few men who have done more personal work in the way of assisting others, especially boys and young men, and by acts of kindness and good council leading them to a higher plane of living both morally and physically. Mr. Robb was an elder and active member of the Presbyterian church of his native town. He was especially interested in the Y.M.C.A. work among boys and railway men, being chairman of the Y.M.C.A. Railway Branch. At the time of his death he was assisting in the management of the Y. M. C. A. Boy's Camp, which every year gathers the boys for an outing at some one of the lovely spots on the sea coast of Nova Scotia or New Brunswick. Through his intense desire to do good he was able to wield a large influence, not only in his own town, but in many districts all over the maritime provinces.

In 1883 Mr. Robb married Miss Jessie MacFarlane, neice of Senator MacFarlane, of Wallace, who, being also devoted to the work of religious organization, has been a congenial companion and helper in this department of his labor. She with her three children have the sympathy of many who mourn the loss of one who was ever a true friend.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

NOTE.—Secretaries of Associations are requested to forward matter for publication in this Department not later than the 25th of each month.

KINGSTON NO. 10.

Kingston association is apparently progressive. At a meeting on September 16th, a large number were present. In the absence of President Simmons, the chair was occupied by Vice-President Asselstine. The regular business being concluded, an interesting discussion took place on the merits of Taylor's hydraulic air compressor. The question-box contained a number of difficult problems, which were worked out on the blackboard. It was reported that a change had been made by the Executive in the members of the Legislative Committee, which is now composed of one member from each association at Toronto, Montreal, Ottawa and Kingston.

LONDON NO. 5.

An open meeting of the above association was held early in September, the chair being occupied by Mr. J. D. Campbell. Mr. G. B. Risler, past-president of the association, made a few remarks, stating that the object of their meetings was to mutually assist and instruct each other in the acquirement of greater knowledge by the interchange of members' ideas in engineering matters. The engineer could well be proud of his calling, and his true aims should be safety, reliability, intelligence and economy. It was the engineer who could, by skilfully managing his steam plant, bring about a good dividend for his employer. Addresses were delivered by Mr. Robert Angus, superintendent of E. Leonard & Sons, and Mr. Thos. McHattie, locomotive foreman of the G. T. R.

BERLIN NO. 9.

DEAR SIR,—The following is a correct list of the officers of the C. A. S. E., No. 9, Berlin: Past-president, W. Oelschlager; president, Geo. Steinmetz; vice-president, J. Heyd; secretary, W. J. Rhodes; treasurer, Wm. Tiedt; conductor, J. L. Bowman; door-keeper, Augt. Prizgodda; trustees, Oelschlager, Amdt, Sararas; auditors, Steinmetz and Oelschlager. The association meets every Friday evening.

Yours fraternally,
W. J. RHODES, Secretary.

MOONLIGHT SCHEDULE FOR NOVEMBER.

Day of Month.	Light.	Extinguish.	No. of Hours.
	H.M.	H.M.	H.M.
1....	P.M. 10.30	A.M. 5.30	7.00
2....	" 11.30	" 5.30	6.00
3....	.....	" 5.30	4.40
4....	A.M. 12.50	.....	
5....	" 1.50	" 5.30	3.40
6....	" 2.50	" 5.30	2.40
7....	No Light.	No Light.	.....
8....	No Light.	No Light.	.....
9....	No Light.	No Light.	.....
10....	No Light.	No Light.	.....
11....	P.M. 5.20	P.M. 7.40	2.20
12....	" 5.20	" 7.40	2.20
13....	" 5.20	" 8.40	3.20
14....	" 5.20	" 9.50	4.30
15....	" 5.20	" 10.50	5.30
16....	" 5.10	" 11.50	6.40
17....	" 5.10	A.M. 12.50	7.40
18....	" 5.10	" 2.00	8.50
19....	" 5.10	" 3.20	10.10
20....	" 5.10	" 4.30	11.20
21....	" 5.10	" 5.40	12.30
22....	" 5.10	" 6.00	12.50
23....	" 5.10	" 6.00	12.50
24....	" 5.10	" 6.00	12.50
25....	" 5.00	" 6.00	13.00
26....	" 5.00	" 6.00	13.00
27....	" 5.30	" 6.10	12.40
28....	" 5.30	" 6.10	12.40
29....	" 5.30	" 6.10	12.40
30....	" 5.30	" 6.10	12.40
.....			
Total,			214.20

QUESTIONS AND ANSWERS.

We have received the following answers to the engineering questions asked in our September issue :

ANSWERS BY MR. A. M. WICKENS.

"ONTARIO" : (1.) Should use oil carefully. Put up a tin or metal splashers to keep oil off the belt. (2.) In raising the speed you increase the horse power ; and in lowering the speed the horse power is decreased—the boiler pressure remaining the same. (3.) It is most economical to carry the pressure of such a height that the point of cut-off is between $\frac{1}{4}$ and $\frac{3}{8}$ of the stroke ; the release should be very near the atmospheric pressure. There is not sufficient data for the latter part of the question to be answered intelligently. What kind of pumps ? What is the system of the drying room, live steam or exhaust ? If exhaust, what is the back pressure ?

"SUBSCRIBER" : If subscriber's engine is $9\frac{1}{2}$ " diameter $\times$ 12" stroke, the piston speed at 280 revolutions per minute is 560 feet per minute. 80 pounds of steam cut off at $\frac{1}{4}$ stroke is equal to a ratio of 4. This would give an M. E. P. of 41.68 lbs. per square inch. The piston, being $9\frac{1}{2}$ " in diameter, has an area of $9\frac{1}{2} \times 9\frac{1}{2} \times .7854 = 70.88$.

$$\frac{70.88 \times 560 \times 41.68}{33,000} = 50 \text{ h. p.}$$

250 amperes at 115 volts = 28,750 watts.

$$\frac{28,750}{746} = 40 \text{ h. p.}$$

"J. G." can use an exhaust steam for heating his building by piping it correctly and having sufficient radiating surface. If his coils or radiators have surface enough to heat the building at, say, 2 lbs. pressure, he can get a perfect circulation by adopting the principle of giving the steam ample room to travel, and giving plenty of fall in the direction of travel ; first, run a main riser of ample size near the centre of the building, and up to the coils of the top flat. This main should have no outlet except those going to coils or rods. Tap the riser for the coils each way several feet above the coil, and set coil with good fall. At each end of building put up relief pipe riser, with safety valve on top ; set to blow off at 2 lbs. Discharge all coils into these. At the bottom of each riser a relief or drain pipe should be put in and be piped to tank or hot well or drain.

"JAS. JOHNSTON" : You should put in good bridge walls back of gates, a damper at the stack mouth, and fire carefully—regulating by stack damper.

"JAS. MCPHERSON" : One of the boys thinks that if you have run that elevator without oil for four years, it would be a waste of money to use any now.

ANSWERS BY MR. WM. THOMPSON.

"J. G." : You can hardly expect to heat your building by exhaust steam without some back pressure, no matter how slight. You must also bear in mind that use of exhaust steam at very low pressure will make a serious difference in the heating capacity of your radiating coils. Suppose, for instance, you have a back pressure of only $\frac{1}{2}$ pound per square inch ; then the sensible heat of your steam will be 213° Fahr., while the temperature of your present system with a pressure of 15 pounds is 250° Fahr. Consequently you would require to add 15% more radiating surface to secure present radiating efficiency with exhaust steam under conditions named. You could by use of an automatic back pressure valve, set in exhaust main, maintain a continuous pressure on heating mains, with steam from exhaust from engine, and return all drips to boiler, all surplus steam exhausting into atmosphere. Of course, back pressure on exhaust main would act against engine, but with ample radiating surface this could be reduced to a minimum.

"JAS. JOHNSTON" : Your question covers a very wide field ; everything depends upon construction of your furnaces, how the hot gases are utilized after leaving combustion chamber, etc. A knowledge of exact conditions, with diagram of boiler and setting, would help us to aid you in solving the problem.

"ONTARIO" : (1) Prevention is better than cure ; examine your engine thoroughly and find out where oil comes from, then take steps, by use of shields, good oil cups, etc., to have oil placed where intended, and not on the belt. Addition of whitening, etc., finally only aggravates trouble, and if any of it gets into a bearing look out for a hot journal. Get your belt cleaned by a reliable belt manufacturer, and careful attention will prevent further trouble unless your engine is habitually "dirty." In that case cure is almost hopeless. (2) Increasing the speed of an engine

gives more power ; decreasing speed, less. Usually engine builders design to get best results both for economy and safety at given speeds, and it is not wise to deviate far from this. (3) An automatic cut-off engine is supposed to adopt its steam admission to its load ; consequently a high pressure and light load mean an early cut-off, and in the case of many high speed engines, heavy compression, a too early cut-off, and consequent long expansion is conducive to loss by cylinder condensation caused by the two extremes of temperature. On the other hand, low steam pressure and heavy load means that cut-off will not take place until late in the stroke, and all advantages arising from the use of steam expansively are lost. A steam pressure adapted to the load is the most acceptable, say to cut off at $\frac{1}{4}$, $\frac{1}{2}$ or $\frac{3}{4}$ stroke, according to the economy of your engine. The best pressure is that which gives the most economical point of cut-off. An indicator would be very useful to you, enabling you to determine cut-off with different loads and different pressures, and thus enabling you to decide what pressure is likely to give best results in your particular case.

"SUBSCRIBER" : I do not see how you can hope to gain any decided advantage by placing pipes as suggested, unless they are in direct contact with the flue gases. The quantity of heat that would radiate from breeching to water would be very small. Every unit of heat extracted from flue gases reduces the intensity of your chimney draft a corresponding degree. The greater the difference between the temperatures of the external air and internal gases, the greater the intensity of the draft. Any cool substance, whether water or air, in contact with the stack, will act as a condenser and extract heat from internal gases. Suggested pipes placed inside of breeching in direct contact with flue gases is practically the principle of "Green's Economiser," and would briefly have a double effect : 1st, the raising of the temperature of the feed water ; 2nd, the lowering of the draft gauge. 1st, by restriction of breeching area for passage of flue gases ; 2nd, by reducing the temperature of flue gases. Reduce product of dynamo to electrical energy or horse power expressed in watts :

Ohm's law is $E \times C = W$

Then $115 \text{ volts} \times 250 \text{ amperes} = 28,750 \text{ watts}$,

and $28,750 \div 746 \text{ watts in one h.p.} = 38.5 \text{ electrical h.p.}$

Next find power engine is capable of developing, cutting off at $\frac{1}{2}$ stroke, with, say, a mean effective pressure of 35 pounds to the square inch. This is done by simple formula :

$$\frac{A N P S^1}{33,000} = \text{h. p.}$$

When A = area of piston in square inches.

N = number of strokes per minute.

P = mean effective pressure.

S^1 = length of stroke in feet.

Then $9.5^2 \times .7854 = 70.88 \text{ sq. in. area of piston}$; and

$280 \text{ revolutions per minute} \times 2 = 560 \text{ strokes per minute.}$

$$\frac{70.88 \times 560 \times 35 \times 1}{33,000} = 42 \text{ h. p.}$$

There is, however, a loss of power between the engine cylinder and the terminals of the dynamo, varying in accordance with the conditions under which the dynamo is operated, but which in modern plants should not exceed 10 per cent., which is about, in your case, the difference existing between generator and engine with a boiler pressure of 80 pounds and an M. E. P. of 35 pounds to the square inch. The method of calculating M.E.P. and H.P. will be fully detailed in educational department in due course.

ANSWERS BY MR. JAMES MILNE.

"ONTARIO" : The exhaust steam can be readily used for heating purposes without making any great difference on the back pressure, by having the combined area of the pipes leading to the various departments equal to, if not greater than, the exhaust pipe.

"JAMES JOHNSTON" : Don't know what could be done to reduce the temperature of gases. The trouble lies in the design of the boiler.

"ONTARIO" : (1) With Armington & Sims engines, together with the majority of these high-speed engines, this trouble is very common and hard to get rid of. One remedy, or rather partial remedy, is to use grease, and as little oil as possible. Unless your belt is completely saturated with oil, whitening or chalk should prevent slipping for considerable time. You should not scrape it while running. (2) By increasing speed the power of an engine is also increased. (3) The most economical pressure is from 80 to 100 lbs. for simple high speed engines. The higher the pressure is the less steam is used.

"SUBSCRIBER" : A very long length of piping would be required to increase the temperature of your water to any considerable degree. It would reduce your draft a little. If your gases are

only 450°, we don't think it would pay you to do it. The horsepower of an engine can be calculated by the following formula :

$$\frac{P \cdot L \cdot A \cdot N}{33,000}$$

Where P = Mean effective pressure.
L = Length of stroke in feet.
A = Area of piston in square inches.
N = No. of strokes per minute.

In your case the unknown quantity is P, which can be arrived at near enough for your purpose, in this manner :

Suppose the engine cuts off at $\frac{1}{3}$ stroke, which is equal to a ratio of expansion of three.

The mean pressure is = Initial absolute press. $\left(\frac{1 + \text{hyp. log of } 3}{3} \right)$

∴ Mean effective press. =

Initial abs. pressure $\left(\frac{1 + \text{hyp. log of } 3}{3} \right)$ - back pressure.

The initial pressure = 80 + 15 = 95, and the back pressure of the engine is non-condensing, say

5 lbs. above atmosphere = 20 lbs. absolute.

Then M.E.P. = 95 $\left(\frac{1 + 1.098}{3} \right)$ - 20 = 46.5 lbs. = 46.5 lbs.

From this the h. p. of the engine can be calculated.

$$\text{h. p.} = \frac{46.5 \times 1 \times 70 \times 560}{33,000} = 55 \text{ h. p.}$$

To run your dynamo to the load, viz., 250 amperes, at 115 volts, would take, including friction, etc., nearly 50 h. p. Therefore your engine is large enough.

"JAMES MCPHERSON": Oil is not necessary.

ANSWERS BY THE ROBB ENGINEERING COMPANY.

"J. G.": The Barnard system is a very effective and simple system of exhaust heating. Write for particulars to Geo. A. Barnard, 39-41 Cortlandt street, New York City.

"JAS. JOHNSON": You can reduce the temperature of flue gases by reducing the grate surface or increasing the heating surface of your boiler. The heating surface may be increased by placing in smoke flue a small economizer of the Green type, consisting of vertical pipes between which the gases pass on their way to the chimney, and the feed water by being passed through the tubes is heated to 250 to 300 degrees.

"ONTARIO": (2) Most high speed engines are designed for about a certain speed, at which they will run smoothly and regulate best, but a variation of 25 revolutions above or below the rated speed may be made without any serious disadvantage, provided the governor is properly adjusted. (3) 80 lbs. pressure would be more economical than 50 lbs., provided the work being done is sufficient to require the cut-off to be as late as $\frac{1}{4}$ stroke or later. If the engine is underloaded a less pressure might be more economical in order to prevent too early cut-off and too great expansion. It is not economical to expand more than three or four times in a single cylinder.

"SUBSCRIBER": It would not pay to put water pipes on the outside of your flues. You could use Green's economizer to advantage if you have sufficient draft, but not without. A $9\frac{1}{2} \times 12$ " A. & S. engine running at 250 revolutions should develop about 40 horse power at $\frac{1}{4}$ cut off, and would work up to about 56 horse power at latest point of cut-off. 250 amperes at 115 volts = $\frac{250 \times 115}{746} = 38.5$ electrical horse power; add 25 per cent. for friction

and loss in engine, and dynamo would equal about 48 horse power. The engine should do this without being too greatly overloaded.

ANSWER BY "JEAMES."

In answer to "James McPherson," I have been using cylinder oil and some times common machine oil. I don't really know if it is necessary to give it much oil. How about the piston packing being chewed up by it and the valves in your pump, if you have one? There is one thing I would like to know, and that is how to stop that everlasting grunting and groaning in the steam end of elevator pumps. They are nearly all the same when put on elevator work. I know of three different makes, so it is not the makers' fault. I notice that when the pump is going at her speed she is all right, but the minute she slows down that minute she begins to groan and scrape. Would it be any use feeding graphite? But, then, a sight feed would not take it. Pointers will oblige.

SIR,—As I have been thinking of altering my boiler setting, I would like, before doing so, to know what is the generally accepted plan. There are many others like me who do not really know whether their conditions are right or not, and who would be glad of enlightenment on the subject; so to try to benefit others as well as myself, I have thought of asking the following questions, with the hope that superintendents or engineers will give us the sizes as in their plants. Each man looking for the information would therefore be able to pick out his own size boiler, etc., and compare conditions and results. If some of our large engine builders and engineering expert friends could be got to give us their opinions, the time it would take them to do so would not be lost.

What size are your boilers, length, diameter, size of tubes and number of same; how much heating surface and what is h. p. of boiler?

Size of furnace, length, breadth and height from boiler?

Kind of grate bars, shaking or stationary, what air space, and how are bars placed?

Height of bridge wall from boiler, and how built?

Depth of combustion chamber and how it is shaped back of bridge wall?

What should be the ratio between grate surface and heating surface and between tube area and grate (for different fuels)?

What air openings, if any, and where situated, bridge wall or sides of furnace?

What mode of firing and thickness of fire, and what is found to be the most economical rate of consumption per square foot of grate per hour?

How do you bank your fires?

When unable to weigh coals, but passing water through a meter, how much water should a boiler of a given size be able to use and be up to its economical limit? Under that amount we would understand that it was too large for the work required, and over that we would say it was being forced?

What should draft be at chimney and at furnace?

Have you ever used forced draft and with what result?

What should temperature of flue gases be?

What is the efficiency of your boiler?

When wishing to check draft whether would you close damper in flue or close ashpit doors, taking into consideration that when closing damper in flue you choke tubes with soot?

How are your boilers covered in? Does the flue return on top again or do you use top of boiler as a dead flue, i.e., gases get on top but no circulation, or when boiler is bricked in at sides in usual way do you have bricks or other covering lying directly on top, or do you have an air space between boiler and covering?

Have you any arrangement for heating feed water apart from exhaust steam water? If so, explain it.

Do you think it is better to force a boiler for a few hours or cut in another one?

What does a pyrometer cost and would it be of any value to have it?

Besides giving sizes, etc., a few remarks as to the advantages or disadvantages of any of the points would be advisable.

ALFRED O. PEACH.

"INDICATOR" writes: I was thinking of putting on an indicator on my engine, an A. & S. Would some one give me all the sizes for the correct rigging and how to set it up? Please indulge in no generalities, as I have had no experience in this matter. My engine has 12 inch stroke.

SIR,—Would you please ask in your first issue: (1) Whether it is best to run with dirty flues or to run with clean flues and damper, say, half shut. Closing the damper makes sooty tubes. My boiler fully half the time is too large and I cannot brick up grates. (2) Is a return steam trap or an injector the most economical in steam consumption for boiler feeding? (3) I have a steam drum used for drying purposes through which the steam at 50 pounds blows, slightly throttled on discharge side, and I should like to connect it on to a nason trap, if it would work through the following piping: Drum stands 3 feet from floor; discharge pipe would have to dip 30 inches below floor, then rise 3 feet in a length of, say, 10 feet and connect on to another pipe going to the trap. I would put on a check valve just before it connected on to the other pipe.

ONTARIO NO. 2.

"WILLIAM HIGGINSON" writes: "We have a steam plant here driving the electric lights, which is going to be too little for the work we can get for it to do, and we are thinking of putting in storage batteries to carry the peak of the load for about four hours. Can you inform me where any batteries are now in use to carry the peak of the load as above mentioned?"

ANSWER.—We do not know of any plant in Canada using a storage battery to carry the peak of the load. There are several battery plants in use, but none of them are used for that purpose. Henry Morgan, Montreal, and the Toronto University Chemical Laboratory have them, but use them only when the generator plant is shut down.

"T. C. D.," Guelph, Ont., asks: "What are the names of the principal slow and medium speed steam engines, slide valves, fitted with fly ball governors, used in England, and what is the most popular governor regulator used in England?"

ANSWER.—There are so many engine builders in England that it is pretty hard to give "the principal" ones. Messrs. John Fowler & Co., engineers, Leeds; Roby & Co., Globe Works, Lincoln; Ransomes, Sims & Jefferies, Limited, engineers, Ipswich and London; and Tangyes, Limited, Birmingham, are among the most prominent. We cannot advise you at present as to the most popular governor.

The Gutta Percha & Rubber Company, West Lodge avenue, Toronto, have lately installed a 60 k.w. generator, and are wiring their factory for 450 incandescent lamps and 15 arc lamps. All wiring is being done with rubber wire in cleat work. The plant is to be divided into six sections with separate feeders for each section, and having an elaborate switchboard containing switches for each feeder and station instruments. The whole of the work is being installed by Mr. H. F. Strickland, electrical contractor, 35 Adelaide Street East.

TENDERS FOR ELECTRIC LIGHT

Sealed tenders will be received by the undersigned up to noon on MONDAY, NOVEMBER 1ST, 1897, for the furnishing and operation of twenty-nine (29) Arc Electric Light Lamps of twelve hundred candle power each (1,200), on the streets of the Town of Orangeville. Estimates are solicited for a one, two and three year contract. The lowest or any tender not necessarily accepted. For further information apply to

WILLIAM WALLACE,
Chairman Street Lighting Committee, Orangeville, Ont

SPARKS.

Incorporation has been granted to the Strathroy Electric Co., with a capital of \$20,000.

The Electric Light Company, of Revelstoke, B. C., have their power house in course of erection.

The London Street Railway Company have completed the extension of their road to Pottersburg.

The town council of Almonte, Ont., is being urged by rate-payers to purchase an electric light plant.

The Exeter Electric Light & Power Co., of Exeter, Ont., has been incorporated, with a capital stock of \$15,000.

Messrs. O'Reilly & Murphy, of Ottawa, recently installed an electric light plant, consisting of 130 lights, in the Archbishop's palace in that city.

An explosion occurred recently at the Chambers Electric Light Works, Truro, N.S., by which the new engine was almost completely ruined. None of the employees were injured.

For the preservation of wooden telegraph poles the Boucherie process of injecting a solution of sulphate of copper into the pores of the wood is said to prolong their lives to about fifteen years.

The Jenckes Machine Co., of Sherbrooke, Que., shipped last week one of their heavy 50 horse power slide engines, with standard steel tubular boiler, to Desire Thibault, Esq., of East Hereford, Que.

The dam at Magog for the civic electric light plant is completed, and the 50" Crocker water wheel, which is being furnished by the Jenckes Machine Co., of Sherbrooke, is expected to be installed now within a short time.

The Monte Cristo Mining Co., of Rossland, have made a fresh strike, and have ordered a complete new hoisting and pumping plant from the Jenckes Machine Co., of Sherbrooke, which has been supplied from their Rossland stock.

The Great North-Western Telegraph Company, in conjunction with the Spokane & Fort Steele Telegraph Company, have completed the erection of a new telegraph line from Kalispell, Mont., to Warder and Fort Steele, B.C. Other extensions are contemplated in the near future.

Messrs. Ahearn & Soper, of Ottawa, have secured the contract for the telegraph wiring of the Ottawa & New York Railway. The line will extend from Ottawa to Moira, N.Y., and along the cable under the St. Lawrence. The amount of the contract is said to be large.

Water was turned into the flume at the factory of the Boston Rubber Co., at St. Jerome, Que., on the 25th ult. The steel flume, which is 350 ft. long and 6 ft. in diameter, was furnished complete, including a 55" Crocker wheel, by the Jenckes Machine Co., of Sherbrooke, Que.

The power station of the Sherbrooke Street Railway, of Sherbrooke, Que., is rapidly nearing completion, and the turbine plant being installed by the Jenckes Machine Co. is also about completed. Mr. Burke, the president, states that they expect to be in operation by the 15th of October.

Hunter & Oliver, solicitors, of Victoria, B.C., give notice of application to parliament for the incorporation of a company to construct a narrow gauge railway from Portland Inlet to Teslin Lake, with power to build bridges, telegraph and telephone lines, etc., and to supply light, heat and power.

The Consumers' Cordage Co., Limited, of Halifax, N. S., have for some time been considering the adoption of electricity as a motive power for operating their machinery. The manager of the company states that owing to the cost of the machines, they have concluded that it is not economical at present.

The Kootenay Electric Co., of Kaslo, B.C., are utilizing the new water power to generate electricity, and have placed an order with George C. Hinton & Co. for a 150 k.w. "S. K. C." generator complete, with transformers and motors. The latter firm are agents in British Columbia for the Royal Electric Co.

The Parry Sound Electric Light Company held their annual meeting on September 7th. Directors were elected as follows: Messrs. S. Armstrong, William Beatty, Dr. Walton, W. H. Pratt, J. J. Jolliffe, J. F. Mossley and Dr. J. R. Stone. The company have now over 900 private lights and 40 street lights under contract.

The Bridgewater Power Co., of Bridgewater, N. S., have lately been reconstructing and enlarging their electric light plant, and have replaced their three wire system by an alternating current system, for which purpose they have purchased a 40 k.w. "S. K. C." two-phase generator from the Royal Electric Co., and 600 light capacity in transformers.

The total length of the world's telegraph system is given as 4,908,921 miles, exclusive of 180,440 miles of submarine cables. Of this, Europe has 1,764,790 miles; Asia, 310,685 miles; Africa, 99,419 miles; Australia, 217,479 miles, and America, 2,515,548 miles. These figures are given by United States Consul Germain, of Zurich, to the State Department.

The Electric Light Company at Dartmouth, N. S., are introducing the meter system. The rates for lights so supplied will be 12½ cents per one thousand watt hours, or ½ cent less if meter is owned by consumer. Where bills are less than \$2.50 a month a rental of 25 cents a month will be charged for the meter when it is supplied by the electric light company.

At a recent trial on the Ottawa river a new invention, called the submarine searchlight, proved a decided success. The searchlight showed the bed of the river plainly for a circumference of 50 feet; and at a depth of 35 feet objects could be distinguished

without any difficulty. The object of the inventor is to enable divers to perform their work with accuracy and to trace lost treasure. It is especially adapted to assist the workers on wrecked vessels lying underneath the water at a great depth. The inventor is Mr. Joseph de l'Etoile.

Mr. Geo. Eastbrook, who is about taking his departure for Delagoa Bay, South Africa, where he is erecting flouring mills and other industries for a wealthy syndicate of Canadians, is taking with him a complete electric lighting plant. The apparatus and material complete are being purchased from the Royal Electric Co. This we believe is the first instance where a Canadian electric lighting plant has been sold for service in the antipodes.

From a carefully prepared table of statistics published in a German contemporary it appears that 80 per cent. of the continuous current stations in that country are provided with accumulators, the total output of which is 31 per cent. of the whole power of these stations. Notwithstanding such figures as these, there are many American electrical engineers who still doubt the advisability of installing accumulators in connection with central stations.

The water power of the Shawenegan Falls, on the St. Maurice river, in Quebec, was recently sold by the Crown Lands Department to Mr. David Russell, of Montreal, who is said to represent a strong syndicate intending to manufacture calcium carbide for acetylene gas. One of the conditions of the sale was that the purchasers should expend \$2,000,000 within eighteen months on the erection of buildings and plant and in developing the water power, and a further \$2,000,000 within the next two years.

Wireless telegraphy is occupying a good deal of attention just now, and to accompany the encouraging reports from Mr. Tesla of his advances and success with new apparatus for such work, we note the statement from Marconi that he is about to signal electrically without wires from St. Paul's Cathedral, London, to the Eiffel Tower, in Paris, a distance as the crow flies of perhaps 150 to 200 miles. It will be interesting to see what comes of all this movement, which may well betoken a new advance in electrical discovery and invention.

According to a London exchange, a report on the electrical and allied trades in Cape Colony is being prepared by Mr. A. P. Trotter, honorary correspondent for that district of the London Chamber of Commerce. In his report, Mr. Trotter will allude to the prospects of employment for electrical engineers in South Africa. He desires it to be made known that no electrical engineers should go to South Africa at present unless they have secured definite appointments before sailing. Many competent electrical engineers in that country are now unable to find employment.

The Nelson Electric Light Company, of Nelson, B.C., have declared a dividend of 12 per cent. for the financial year just closed. This company have elected directors as follows: John Houston, president and manager; John J. Malone, vice-president; J. H. Matheson, secretary; John Johnson, treasurer; J. Fred Hume, J. A. Mara and John Hamilton, directors. The city council has recommended that the offer of the company to light the streets for a period of five years be accepted, provided they agree to dispose of the plant, franchise, etc., to the city within one year at a price not to exceed \$40,000.

The interest in the electric railway question in England has extended as far as the question of trolley car etiquette, as will be seen from this quotation from a London contemporary: "We are told that another peculiarity of the American street cars is that ladies are not allowed to stand in them. When a lady enters a crowded car a seat is promptly vacated for her convenience. No doubt this is sometimes done even in England, but rarely in the same way, with the result that while here it is recognized as courtesy and thankfully acknowledged, there it is taken as a right, for which no thanks are necessary."

The Willow Creek Gold Mining Company, of which Mr. E. Todd, of Brantford, is president, are about to undertake the construction of an electric railway from Bell City to Island Bay, on Bad Vermillion lake. The railway will be four miles in length, and will be extended as occasion demands. It is proposed to utilize the water of the falls on the Vermillion river and Grassy lake for power purposes, and to put in sufficient electrical machinery to operate a custom stamp mill, as well as the railway. Mr. M. W. Hopkins, electrical engineer for the company, will shortly make a report on the water power.

Among the visitors to British Columbia recently were Messrs. George G. Ward and S. S. Dickenson, general manager and superintendent respectively of the Commercial Cable Co., of Canso, N. S., where the cable connects with the land line. Regarding the Australian cable question, Mr. Ward stated that it would undoubtedly be built at an early date, and in his opinion its construction was warranted. If Vancouver was the terminus, as undoubtedly it would be, he stated that his company would probably work in connection with the Australian cable, and for that purpose he had examined the proposed landing place and secured all the information possible on the subject.

The Hull Electric Company and the Ottawa Electric Company are engaged in a legal combat over the privileges of electric lighting for the city of Hull. The former company claims to have an absolute and exclusive privilege for lighting the city for 35 years, and asks the Ottawa company to remove their poles and electric apparatus and to pay them \$20,000 damages. On the other hand, the Ottawa Electric Company states that the corporation of Hull, as far back as 1887, granted the company permission to erect poles and furnish electric lighting, and that the by-law passed by the corporation in 1894 granting the privilege to the Hull Electric Company does not affect their rights.

EDUCATIONAL DEPARTMENT

INTRODUCTORY

After mature deliberation the publisher of this journal has decided to devote a certain amount of space each month to what may be termed an Educational Department, wherein both mechanical and electrical formula and mathematical problems will be discussed, illustrated, and as far as possible rule and example given. At the request of the editor, I have with pleasure undertaken to contribute to this department regularly each month, and before discussing actual mathematical problems, wish to briefly introduce the subject at issue.

The primary object of this department is chiefly to increase the value of an already valuable paper, by placing in the hands of every engineer who has any knowledge of the rudimentary principles of mathematics, such matter as will enable him by a little study to master the most intricate mechanical and electrical formula. Many of our most valuable engineering works and publications from time to time contain formula that is in many cases but vaguely understood, and very often entirely misunderstood, thus rendering an otherwise valuable work practically valueless to the reader.

Just at what particular point our calculations should commence became a matter of serious thought, and past experience had to be carefully considered, bearing in mind the fact that there are many really good engineers whose early education has, through force of circumstances, been deficient, and many others who, through lack of opportunity, have not been able to review their early education for years. Knowing by observation and experience the great necessity of having a thorough elementary education before attempting to digest and calculate problems, and the almost utter impossibility of the student arriving at a satisfactory conclusion of his study without a thorough knowledge of the principle of mathematics involved, I have decided to commence at a point and carry out the programme outlined in this journal—commencing at the foundation and advancing by easy stages until the principles underlying the most obtuse and difficult formula can be readily explained and easily understood. The advantages to be derived from an education of this kind, coupled with practical mechanical ability, is too well understood to require comment.

The programme which has been outlined for the succeeding nine months will embrace:

DECIMAL FRACTIONS—Definitions and explanation of principles of, and method of reduction to common fractions, and vice versa.

SQUARE AND CIRCULAR MEASURE—Definition and explanation and practical demonstrations of.

CUBICAL AND CYLINDRICAL MEASUREMENTS—Definitions and explanations of, with practical hints.

SQUARE AND CUBE ROOT—Definitions and explanations of.

SAFETY VALVE CALCULATIONS—(Spring and Lever Types)—Principles of, with practical demonstrations.

BOILER CONSTRUCTION—Stays, rivets, joints and seams, iron and steel plate—strength of, with formula and practical demonstrations.

It is not the intention to fill these columns with a mass of figures hastily compiled without reference to any particular object; on the contrary, every problem will be carefully thought out, and only such information given as will be of use to you, and an effort will be made, based on experience and a knowledge of the requirements, to make his series of tests complete in every particular.

WM. THOMPSON.

[ARTICLE VI.]

SAFETY VALVE CALCULATIONS.

(Continued.)

SPRING-LOADED SAFETY VALVES.

THE questions of most importance to the practical working engineer regarding spring-loaded valves are: Size of steel from which the spring shall be made; required inside and outside diameter; compression required to have given effect.

A standard spring, if made of the best square steel, contains an area of .25 of a square inch, the inside diameter is exactly two inches and outside diameter three inches; it contains thirteen complete coils, and measures exactly eleven and one-half inches in length. The working load is assumed at 600 pounds, one-sixth of its breaking load when hardened to a temper just sufficient to break it; at this load it should deflect exactly one inch.

Example (1): A safety valve 4 inches in diameter has a spiral spring made of square steel 3" diameter outside and .25" thickness of steel; what will be the pressure per square inch?

Formula:

$$\frac{12,000 S^3}{d} = \text{whole pressure on valve.}$$

Where S = thickness of steel in inches,

d = diameter of spring from centre to centre of steel,

12,000 = constant used for square steel,

8,000 = constant used for round steel.

$$\text{Then, total weight} = \frac{12,000 \times .25^3}{2.5} = 600 \text{ pounds.}$$

Diameter of valve is given as 4 inches. Area of valve then = $4^2 \times .7854 = 12.5664$ square inches. $\therefore$ pressure per square inch = $600 \div 12.5664 = 47.7$.

The foregoing is the fundamental principle to connect the loading of the spring valve with that of a direct weighted valve, and from it may be obtained both the proper thickness of steel to be used and the proper inside and outside diameters of the spring.

Example (2): What must be the outside diameter of a spiral spring for a safety valve 5" in diameter? The pressure to be carried is 50 pounds, and the diameter of the steel is $\frac{3}{4}$ inch.

Formula:

$$d = \frac{8000S^3}{W}$$

Where d equals as before the mean diameter of the spring, S thickness of steel, W the whole weight on the valve, then

$$d = \frac{8000 \times .75^3}{5^2 \times .7854 \times 50} = \frac{3360}{981.75} = 3.42 \text{ inches.}$$

This, however, is only the mean diameter, or the diameter from centre to centre of steel. Therefore, the diameter of the steel must be added to this to get the outer diameter.

$$\therefore \text{outer diameter} = 3.42 + .75 = 4.17 \text{ inches.}$$

Example (3): The diameter of a spring loaded safety valve is 5 inches, gauge pressure 60 pounds, and mean diameter of a spiral spring 5 inches, what must the area be for square steel, also the length of each side, the area and diameter for round steel, and the inside and outside diameter of each spring.

The Steamboat Inspection Act adopts the Board of Trade rule for the determination of the required size of steel under the following formula:

$$\frac{\sqrt[3]{W \times d}}{c} = s$$

s = Side or diameter of steel in inches.

w = Load on spring in pounds.

d = Diameter of spring from centre to centre of steel.

c = 12,000 for square steel.

c = 8,000 for round steel.

Then we require to multiply total load in pounds by mean diameter in inches, and divide by either constant 12,000 or 8,000, as the case may be, and cube root of quotient equals diameter of steel.

First find what w of formula represents, by multiplying area of valve by pressure per square inch.

$$\therefore w = 5^2 \times .7854 = 19.635 \text{ sq. in. area.}$$

$$19.635 \times 60 = 1178.1, \text{ total weight.}$$

$$1178.1 \times 5 = 5890.5.$$

$$\text{Then } \frac{\sqrt[3]{5890.5}}{12000} = \text{diameter for square steel.}$$

$$\text{and } \frac{\sqrt[3]{5890.5}}{8000} = \text{diameter for round steel.}$$

$$5890.5 \div 12,000 = .49, \text{ and } \sqrt[3]{.49} = .788 \text{ inches length of each side for square steel.}$$

$$.788 \times .788 = .62 \text{ square inches area of square steel.}$$

$$5890.5 \div 8000 = .736, \text{ and } \sqrt[3]{.736} = .9 \text{ inches diameter of round steel.}$$

$$.9^2 \times .7854 = .63 \text{ square inches area of round steel.}$$

For a spring constructed of square steel our dimensions then become:

Mean diameter of spring (i.e., from centre to centre of steel) = 5 inches
Outside diameter of spring equals 5 inches plus size of steel = 5.788 inches
Inside diameter of spring equals 5 inches minus size of steel = 4.212 inches
Size of steel = .788 inches
Area of steel must contain 62 sq. in.
And for a spring constructed of round steel, dimensions are as follows, viz.:

Mean diameter of spring 5 inches
Outside diameter of spring is 5 in. + .9 = 5.9 inches
Inside diameter of spring is 5 in. - .9 = 4.1 inches
Diameter of steel wire = .9 inches
Area of steel must contain 63 sq. in.

With a standard spring before us it is easy to determine the required sectional area of any steel spring when fundamental principles of this formula are understood.

As we are given the whole of the dimensions of a standard spring made of spring steel, we can determine the sectional area of a square spring by the following process:

As given weight is to required weight so is given sectional area to required sectional area.

For example, let us compare our determination of sizes for a square spring with a standard spring; our question then becomes:

$$\text{As } 600 : 1178.1 :: .25 : \text{required area.}$$

$$\text{Then } 1178.1 \times .25 = 294.5.$$

$$294.5 \div 600 = .49, \text{ sectional area of spring at a load of } 1178.1 \text{ pounds.}$$

$\sqrt[3]{.49 \div .7854} = .788$ required size of steel to comply with standard spring. All other dimensions of the spring will change in same proportion.

With spiral springs then there is to the practical operating engineer the important question of determining the increase in pressure by compression or the decrease in pressure by reducing the com-

pression, or the change similar and corresponding to the graduation of a lever safety valve.

The formula for this is $\frac{W \times d^3}{S^4 \times G} \times n = \text{total compression}$.

Where W is the total weight pressing upwards against the valve in pounds

d = mean diameter of spring

S is thickness of steel in sixteenths of an inch

G is constant 30 for square steel

G is constant 22.8 for round steel

n is number of coils in spring.

Example (3): A spring loaded safety valve 5 inches in diameter is set for a gauge pressure of 90 pounds, but owing to weakness of boiler, pressure must be reduced to 60 pounds; the outer diameter of spring is five inches and spring is made of $\frac{3}{8}$ inch steel with 15 coils; what compression must be given to produce required pressure starting with spring slack?

$$\frac{W \times d^3}{S^4 \times G} \times n = \frac{5^2 \times .7854 \times 60 \times 4\frac{3}{8}^3 \times 15}{10^4 \times 30} = 4.932 \text{ inches, total compression required.}$$

From this formula may be deduced the number of coils required, so that a given pressure shall require a given compression, or the load on the valve with a given compression, the diameter of coil or thickness of steel, if the other quantities are given.

The most important of these to the engineer is the determination of the number of coils required; the change in pressure by a given change in compression, and also the determination of the total weight bearing down against the valve or the weight required to lift it off its seat when dimensions of spring and compression are known.

To determine the number of coils required to balance a given pressure with a given compression, we construct from above formula the following:

$$C \div \frac{W \times d^3}{S^4 \times G} = N.$$

Where W, d^3 , S^4 , G and N have same values as in last formula, and C equals compression in inches, result will be required number of coils.

To determine pressure at which valve will blow off, with a spring of given dimensions and given compression.

Formula:

$$\frac{S^4 \times G}{a \times d^3 \times N} \times c = P, \text{ pressure at which safety valve will blow off.}$$

a equals area of valve in inches.

To determine total weight holding the valve in place, with a valve of given dimensions and given compression.

Formula:

$$\frac{S^4 \times G}{d^3 \times N} \times c = W, \text{ total weight holding valve down.}$$

Reference has been made to every safety valve requiring a given orifice or opening to allow of free passage of steam, so that increase in boiler pressure shall not take place. It is at the same time just as important that area of valve should not be too great to allow the free discharge of steam.

For steam above 10 pounds pressure above the atmosphere, the weight of steam that will escape into the atmosphere through an opening one square inch in area is, in 70 seconds, just equal to the pounds in the absolute pressure of the steam per sq. inch.

Example: To what height must a 5 inch safety valve rise from its seat to allow steam to escape at the rate of 9,200 pounds per hour, if the pressure on the boiler is 75 pounds per sq. inch above the atmosphere.

Since the weight of steam that will escape per square inch in 70 seconds is equal to gauge pressure plus atmospherical pressure, we proceed to find the weight of steam escaping from one sq. in. per hour.

Gauge pressure, 75
Atmosphere, 15

90, absolute pressure.

Then as 70 : 60 :: 90 : to the weight of steam escaping per minute.

Then, $\frac{60 \times 90 \times 60}{70} = 4628.5$, pounds of steam per hour per sq. in.

Then as 4628.5 : 9,200 :: 1 sq. inch to required area,

$$\frac{9200}{4628.5} = 1.98 \text{ square inches of escape required.}$$

Then if required area is divided by circumference of valve in inches, result will be distance valve will be required to raise from its seat to allow the escape of 9,200 pounds of steam into the atmosphere.

3.1416

$\frac{5}{15.7080} = \text{circumference.}$

.126

$\frac{8}{1.008} = \text{Lift must be } \frac{1}{8} \text{ of an inch.}$

From this, weight of steam escaping into the atmosphere from any orifice may be determined.

OHM'S LAW.

As stated in our last, and following out the principles therein set forth, the current in a conductor varies directly as the pressure or potential at the terminals, and inversely as the resistance of the conductor. From this then we get the following formula:

$$(1) \quad C = \frac{E}{R}$$

This is known as Ohm's law, and is in continual use in the study of formula underlying the principles of electrical engineering.

In equation 1 we have formula for C, when both E and R are known. It consequently follows that we require but a simple transposition in the terms of our algebraic equation to find any of the quantities E, R or C when any two of them are known.

$$(2) \quad \text{Thus } R = \frac{E}{C}$$

which simply means that the resistance is equal to the electromotive force (E M F) divided by the current, and

$$(3) \quad E = R C$$

meaning that the E M F is equal to the resistance multiplied by the current.

From these equations it will be readily seen that if any two of the quantities E, R or C are given, the third may be found from one of the three equations, and that they are all based on the same law.

The energy in an electric circuit is equal to the pressure or potential at the terminals of the conductor multiplied by the current flowing through the conductor or circuit, and can be expressed in formula as follows:

$$(4) \quad W \text{ or watts} = E \times C$$

Here we have a simple formula for the purpose of finding the electrical energy of a circuit or generator when E and C are known.

But it frequently occurs that we must find W when any two of the units E, R or C are known. In equation (3) we have $E = R C$. With this information before us let us substitute this value of E in (4); we then get

$$W = (R C) \times C \text{ or } C^2 \times R = \text{watts}$$

Again in equation (1) we have

$$C = \frac{E}{R}$$

Substitute this value of C in equation (4), and we get

$$W = \left(\frac{E}{R} \right) \times E \text{ or } \frac{E^2}{R} = \text{watts}$$

Following out then the general principles laid down, we get these formula for the determination of the electrical energy in any circuit when any two of the units E, R or C are known, or in other words the capacity of any circuit or dynamo to do work.

In our mechanical studies we establish the important fact that the energy cannot be destroyed, and that it will occur either as mechanical force or heat, or both.

And when an electrical current is passed through a wire or conductor a certain amount of electrical energy is lost as such, but makes its appearance as heat. Consequently the amount of heat generated must be equal to the electrical energy lost, and must therefore be measured in watts.

Formula: $W = C^2 R$ is the formula generally used for the computation of heat generated in a circuit. If the resistance of a circuit and current flowing is known it is only necessary to multiply the resistance of the circuit by the square of the current to find electrical energy lost in transmission and appearing as heat.

Mr. C. H. Rust, assistant city engineer of Toronto, attended the recent convention of Telephone Superintendents at Detroit. Mr. Rust gives it as his opinion that it would be impossible for any company to compete with the Bell Telephone Co. in Toronto so long as they maintain their present rates.

ELECTRIC RAILWAY DEPARTMENT.

LARGE ENGINE FOR STREET RAILWAY SERVICE.

At the William street power house of the Montreal Street Railway Company there is now running in regular service the large engine recently built for the company by the Laurie Engine Company, of Montreal. Owing to the dark location of the engine, the photograph from which the accompanying illustration was made was not as good as was desired. This engine is said to be the largest and most powerful electric generating engine that has ever been built on this continent. It is of the horizontal cross compound Corliss condensing type, provided with tail rods and back end cross-heads and guides, for the purpose of supporting the weight of pistons, thus relieving the cylinders entirely of this weight and consequent wear (which is the only objection to the horizontal engine as compared with the vertical). This is obtained as follows, viz.: After the pistons are fitted, the rods are supported on points representing the position of the cross-head at either end, the deflection of rod due to weight of piston accurately measured; thus the

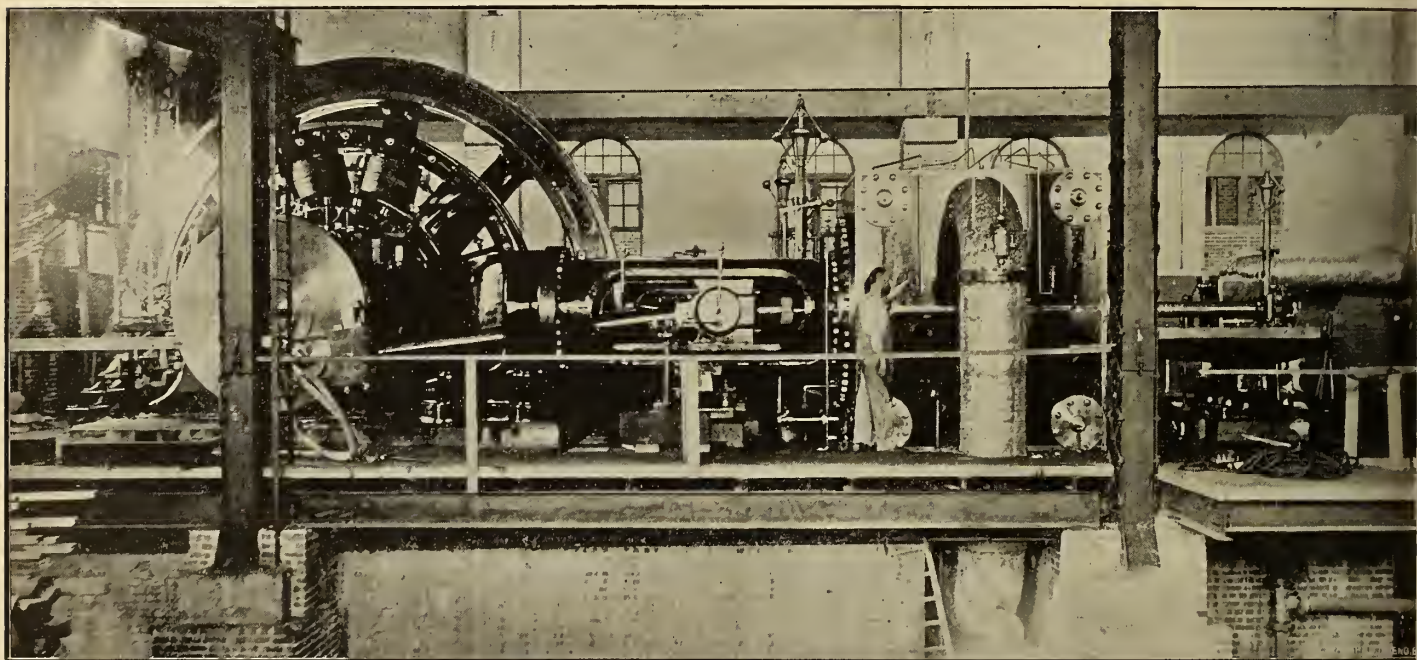
the same time presenting a large bearing surface on the foundation. The main bearings supported by these frames are two feet in diameter and four feet long, the bottom sections (which take the weight of wheel, shaft and generator) of which are water-jacketed.

The air pump is of the single acting, vertical type, and is driven direct from the steam piston rod. The circulating pump is driven from one end of the air pump shaft. The surface condenser is of the Wheeler type.

The engine is designed to work with a pressure of 160 lbs. of steam, at which pressure 4,500 h.p. can be developed. The whole engine weighs 400 tons, and makes a smooth, silent-working machine.

ELECTRIC RAILWAY FRANCHISE IN JAMAICA.

ONE of the largest foreign enterprises that Canadians have yet undertaken is shortly to be carried out in Jamaica, through the efforts of Mr. W. B. Chapman, of Montreal. This gentleman has for some time been negotiating for an electric tramway franchise, and has at last secured a charter from the government to build twenty-five miles on the island, in the vicinity of Kingston, which, it is estimated, will cost half a million dollars. Associated with him are Messrs. F. S. Pearson, of the Metropolitan Street Railway, New York, and Mr. B. F. Pearson,



4,500 H.P. LARGE ENGINE IN POWER HOUSE OF MONTREAL STREET RAILWAY COMPANY.

piston rods are given a permanent deflection equal to that due to weight of pistons. In this way the piston rods are practically straight when supporting full weight of piston.

The dimensions of the cylinders are as follows, viz.: High pressure, 36 inches diameter; low pressure, 64 inches diameter and 60-inch stroke. Both cylinders are steam jacketed throughout.

The valve motion on each cylinder is so arranged and operated that steam may be cut off at any point up to seven-eighths of the stroke. The governor controls the valve motion on both cylinders. An auxiliary governor is provided of same design as the regulator, which is attached to a stop valve in such a manner that should an accident occur to the regulator which would allow the speed of engine to be increased 10 per cent., the auxiliary governor would close the stop valve and thereby stop the engine.

The fly-wheel is 24 feet in diameter, built in ten sections, and weighs about 100 tons. It is secured to a shaft 26 inches in diameter in centre; 24-inch bearings, weighing 21 tons. The wheel was turned on its own shaft, running in its own bearings on the lathe, and therefore runs perfectly true.

The main bearings or frames are enormous castings weighing over 27 tons each, and so designed that the weight of metal is directly in the line of strain, and at

of the Halifax, N. S., Tramway Company, and the enterprise will be known as the West India Electric Company. A large power house will be built on the foreshore, and electric lighting will also be taken up. The contract has already been given to a Canadian firm, and everything entering into the construction and equipment of the road will be Canadian except the rails. Concerning the venture, Mr. Chapman says: For some years this has been a hobby of mine, my attention being first drawn to the matter in 1890. Since then I have been several times to the island, but the old street car company, which has earned large dividends for 20 years, was too influential and barred me out. This year I went down in January, and arranged to buy the old road's rights and assets at a fair price, so gaining a decided advantage in tendering. Then I had to get their general "Tramway Law" amended in many respects to insure our charter being satisfactory when obtained. The next step was to get an act of incorporation passed allowing us to build and operate tramways or generate electricity and distribute it "for any useful purpose." This you see allows us to take up electric lighting and telephone as well, and eventually will give us the entire electrical business on the island, which has 700,000 inhabitants in a very small area. Our troubles were not over then, because a Boston company was competing with us for the "license" from the Governor, which was still necessary to enable us to use our charter. Both parties appeared daily for a week before the Privy Council, and argued their respective cases. The Boston people offered 'penny fares,' but we objected to consider this, and gained our point on general superiority. We have two districts (in city and suburbs) 4 cents each, that is, a maximum of three miles for 4 cents or six miles for 8 cents. Everyone will ride at these rates. We serve immediately about 80,000 people, and will have twenty miles of road in operation within a year, meantime working the horse cars. Only open cars will be required, as the climate is like our July all the year round, excepting May and November, when it rains. We can lay coal down under \$4 per ton, and wages and working expenses are very low."

SPARKS.

The Electric Light Company at Rat Portage, Ont., are erecting a new office building.

The town of Dartmouth, N. S., is at present considering the renewal of its electric lighting contract.

The capital stock of the Halifax Street Railway Company has been increased from \$600,000 to \$800,000.

A gentleman named Baumgarten is said to be negotiating for the construction of an electric railway at Brockville.

The announcement comes from Paris that the Auto-Mobile Club is organizing a monster race of motor cars from Paris to St. Petersburg.

Mr. Fowler, on behalf of a syndicate, is still endeavoring to secure the construction of an electric railway from Lanark to Carleton Place.

The Montreal Park & Island Railway Company held their annual meeting last month, at which the old board of directors was re-elected.

Messrs. A. Bouin, Louis Martin and F. X. Drolet, of Quebec, have been appointed provincial examiners of boiler inspectors for the province of Quebec.

The Montreal Street Railway Company closed its business year a fortnight ago, and the total receipts are shown to be \$1,333,632.84, an increase of \$80,226.07 over last year.

The capital of the Quebec Street Railway Co. is to be increased from \$320,000 to \$400,000, thus enabling the company to complete without delay the whole line intended to be built.

Mr. D. Lamont, manager of the Palmerston electric light plant, states that he finds the ELECTRICAL NEWS very interesting, and considers it as a necessary part of every well equipped plant.

At the annual meeting of the Ottawa Car Co., held last month, directors were elected as follows: T. Ahearn, president; P. Whelan, W. W. Wylie, J. W. McRae, and William Scott.

The Vernon & Nelson Telephone Co., of which Mr. H. W. Kent is superintendent, have commenced the construction of a metallic circuit long-distance telephone line between Nelson and Trail, B. C.

On the 9th ultimo a by-law was carried by the township of King granting a bonus of \$12,000 to the Aurora & Schomberg Railway Co. It is proposed to commence the work of construction in the spring of 1898.

The St. John Street Railway Co. have lately received two new vestibule cars from the Ottawa Car Co. They are said to contain several improvements, including electric buttons on either side of each window, electric heaters, etc.

The Sherbrooke Electric Railway Co. have completed their line from the city limits to the end of Lennoxville. Mr. Mylon, of the Canadian General Electric Co., is looking after the company's interests in connection with the construction of the road.

The city of Montreal has entered an action for \$21,000 against the Montreal Street Railway Co. The city claims that it is entitled to receive a percentage of the receipts taken by the company in the suburban municipalities, while the company contends that it is bound to account only for the receipts within the city limits.

Mr. A. J. Corriveau, of Montreal, has lately returned from a trip over the proposed route of the Montreal Southern Counties Railway. It is Mr. Corriveau's intention to construct the line through Chambly, where the motive power will be obtained. The route embraces St. Johns, St. Alexandria, Bedford, Cowansville, Knowlton, Sherbrooke, Lennoxville and other towns.

John Inglis & Son, of Toronto, have obtained a verdict of \$700 against the Hamilton, Grimsby & Beamsville Railway Co. The company purchased a flywheel for an engine from Messrs. Inglis & Sons, but claimed it was defective and refused payment. The plaintiffs claimed that it was made according to contract and passed by the company, and were awarded judgment as above.

Mr. J. B. Griffith, manager of the Hamilton Street Railway Co., has become financially embarrassed. At a meeting of creditors a statement was presented showing assets of \$48,500, consisting of shares in the Hamilton Street Railway Co. The liabilities amount to \$47,127, of which \$45,227 is secured by the hypothecation of the shares. It is probable the estate will be wound up.

There appears to be friction between the Hull Electric Railway Co. and the management thereof. A short time ago Mr. G. W. Seguin, who was acting as secretary-treasurer, retired from the company, and now it is announced that Mr. H. B. Spencer, superintendent of the road, will probably resign, owing to a desire on the part of the company to reduce expenses. Mr. Spencer was engaged about one year ago as superintendent for five years, at a salary of \$3,000 per year.

The Engineering News states that a contract has been signed by the Southern California Power Company for an 80-mile transmission, which is the longest distance on record, the next one to it being 36 miles for the Salt Lake City plant, in which only one-fourth the power is transmitted at one-third the line pressure used on the Niagara Falls-Buffalo transmission. The power station is 12 miles from Redlands; there will be four three-phase generators of 750 k.w. each, directly connected with impact turbines; 250-k.w. transformers will raise the pressure to 33,000 volts.

It is reported that the Belgian government have decided upon trying electric locomotives on the ordinary state railways. The first experiment is to be made between Brussels and Tervueran, a distance of nine miles. The accumulator system is to be adopted. The accumulators for this service will weigh 12 tons, the electric motors and appliances 10 tons, and the cars, which will carry 80 passengers, 20 tons. The charging of the accumulators occupies one hour for every eighteen miles of running power, but are capable of being charged for seventy-two miles of operation. The motors are to be compound wound and the pressure of current about 500 volts. The success of the trial will be watched with much interest.

TRADE NOTES.

The Foley Mines, Seine River, Ont., are now installing two 100 horse power steel boilers, built by the Jenckes Machine Co., of Sherbrooke.

Mr. C. B. McAllister, of Peterboro', is lighting his new mill by electricity, and has placed an order for the dynamo and fixtures with the Royal Electric Company.

Mr. H. Corby, of Belleville, is lighting his distillery and warehouses with electricity, and has placed his order for the dynamos, etc., with the Royal Electric Company.

D. Champoux & Bro., Disraeli, are installing an electric lighting plant, and have purchased for this purpose a 30" Crocker turbine from the Jenckes Machine Co., of Sherbrooke, Que.

The Galvanic Battery Works Company, of Toronto, in their new catalogue, devotes considerable space to a description of electro neurotomy apparatus for use in the treatment of spinal and other diseases.

The Hawthorne Woolen Co., of Carleton Place, have recently enlarged their premises, and are lighting them throughout with electricity. The contract for electrical apparatus has been awarded to the Royal Electric Co.

The Owen Sound Portland Cement Co., of Shallow Lake, have purchased an electric plant from the Royal Electric Co., and will have the same operating in a very short time. It is their intention to work twenty-four hours per day during the season.

The 30-stamp mill at the Sultana Mines is almost ready to commence operations. This mill is probably the most modern one in the district, and the complete plant with which Mr. Caldwell is equipping the property was furnished by the Jenckes Machine Co., of Sherbrooke, Que.

The Old Ironsides Mine at Greenwood, B. C., have got their new plant, which was furnished by the Jenckes Machine Co., of Sherbrooke, Que., into position, and are now about ready to ship ore. This property is expected to enter the list of dividend payers within the next few months.

In the Machinery Hall at the St. John Exhibition the Robb Engineering Company, of Anherst, N.S., exhibited one of their well-known 40 horse power side crank engines. A railing surrounded a stage, upon which the engine was set, thus forming an ideal engine room. The exhibit was in charge of Mr. J. J. Porter.

The Goldie & McCulloch Company, of Galt, Ont., exhibited at the St. John Exhibition one of their Ideal engines, for which engine is said to make a great saving in oil, using as it does one they have the exclusive right of manufacture for Canada. This oil cup, and is the only self-oiling engine built in the Dominion.

The Robb Engineering Company, Limited, have received an order for three tandem compound engines, side crank type, for export to Spain. These engines are to be direct connected to electric generators, and were ordered by an English engineering firm who are building electric tramways at Barcelona and Madrid.

The Dominion Paper Company, extending and enlarging their mills at Kingsey Falls, Que., have placed an order with the Jenckes Machine Co., of Sherbrooke, for two of their 30" Crocker special turbine wheels. These wheels are mounted on one shaft, set horizontally in a steel case, thus doing away with the gearing and attendant evils.

The Cockshutt Plow Co., of Brantford, have bought additional premises, and are doubling the capacity of their works. Among the important changes is the substitution of electricity for gas. They have placed their order for a 30 k. w. generator and 250 light installation with the Royal Electric Company. The generator is to be of the "S. K. C." two-phase type, wound to deliver 110 volts direct to mains. This system for isolated lighting is a radical departure from the old lines, and is the second instance in Canada where it has been placed in use for factory lighting.

The Thompson Electrical Company, of Hamilton, Ont., report sales of their "T. & T." arc lamps to the following: The Sarnia Gas & Electric Co., Stratford Gas & Electric Co., Guelph Gas & Electric Co., St. Thomas Gas & Electric Co., Preston Electric Light Co., Gananoque Electric & Gas Light Co., Manitoba Electric & Gas Light Co., Wallaceburg Electric Light Co., Hamilton Electric Light & Power Co., Niagara Falls Electric Light & Power Co., Welland Electric Co., Woodstock Electric Light & Power Co., City of Windsor, Ont., Montreal Rolling Mills Co., Ontario Rolling Mills Co., John Bertram & Sons, Garrioch, Godard & Co. A complete 100 arc light plant, including dynamos, lamps and circuits, has been sold to the city of Chatham, Ont., for lighting its streets.

PERSONAL.

Mr. Karl Wildern, inspector for the Bell Telephone Company, was recently married at London, Ont., to Miss Wilkins.

At Victoria, B. C., recently, Mr. Robert W. Harrup, of the British Columbia Electric Railways, was married to Miss Williams.

The resignation is announced of Mr. William Bathgate, who for the past twelve years has been manager of the Winnipeg Gas and Electric Company.

Mr. J. A. Culverwell, formerly with the General Electric Co. at London, Ont., has received the appointment of local manager for Toronto and Central Ontario for the London & Lancashire Life Insurance Company.

RAPID TELEGRAPHY.

PROF. A. C. Crehore and Lieut. G. O. Squier, U. S. A., in a paper read before the April meeting of the American Institute of Electrical Engineers, entitled "The Synchronograph: A New Method of Rapidly Transmitting Intelligence by the Alternating Current," describes a new method of rapid telegraphy. The transmitter consists of a mechanism for opening an alternating circuit at the exact instant when zero value is reached, and keeping it opened during one or more alternation; one or more half waves may thus be omitted according to the requirements of the telegraphic alphabet. By means of a perforated paper band corresponding to the message to be sent, the half waves are omitted in the proper order. The receiver rests on the principle that if a ray of polarized light is passed through liquid carbon bisulphide or one of a number of other substances, the plane of polarization is rotated by any change in value of a magnetic field set up by a coil surrounding the liquid—that is, by any change of current in the coil. This principle is utilized to register the current from the transmitter, by photographic means, the suppression of the half waves above referred to being thus registered at the receiving end of the line

in the form of a record comparable to that printed on a tape by a Morse receiver. The transmitter may also be used in connection with a chemical receiver, such as the Delany. In experiments no difficulty was experienced in obtaining records with the use of a frequency of 545 periods per second, which corresponds to a transmission of between three and four thousand words per minute.

Messrs. A. P. McLaurin & Co., of Lachine, Que., are about to light their factory by electricity. The order for the dynamos and material has been given to the Royal Electric Co.

The Perth Waterworks Co., of Perth, Ont., have decided to do their pumping by electricity and also to light the town of Perth. For this purpose they have placed their order with the Royal Electric Co. for a 150 k.w. "S.K.C." two-phase generator, from which will be driven the pumps by two-phase motors, the balance of the capacity of the machine being used for lighting and power to be furnished in Perth. A more extended description of this plant, which is rather unique, will appear in the next issue of this paper.

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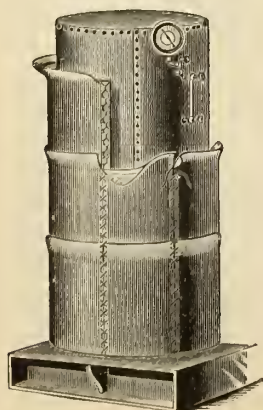
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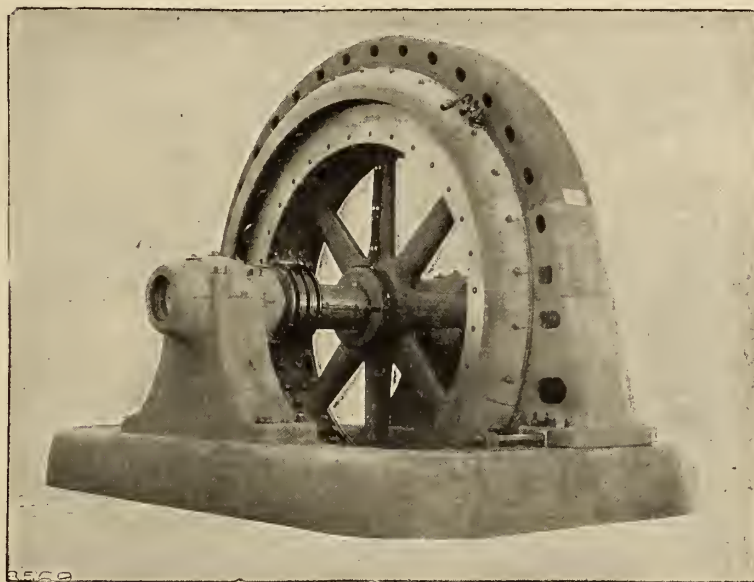
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SPARKS.

Mr. N. Duval, of 85 St. James street, Montreal, has invented a new water wheel which is laid flat in the water.

Rogers, Robertson & Co., oil merchants, Montreal, have amalgamated with the Bushnell Oil Co., Limited, of that city.

The village of Glencoe, Ont., has invited tenders for electric street lighting for a term of five years. Tenders closed on the 2nd inst.

A reduction in fares will, it is said, be made by the Metropolitan Railway Company between the C. P. R. crossing and the cemeteries.

Incorporation will be asked for the "La Compagnie de Téléphone de Beauce," for the purpose of establishing telephone lines in the province of Quebec.

An assignment has been made by C. W. Henderson, dealer in electrical supplies, Montreal. The direct liabilities are given as \$8,327, and the indirect liabilities as \$2,186.

The New England Telephone Company have established a long distance service between Boston and points in Canada, connecting with the wires of the Canadian Bell Telephone Company.

The Sarnia Gas & Electric Light Company recently purchased a new boiler from the Goldie & McCulloch Co., of Galt, and an incandescent machine from the Canadian General Electric Co.

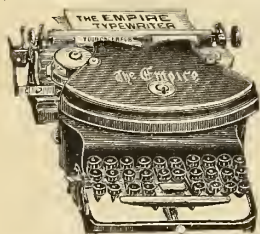
The receipts of the Toronto Street Railway Company for the year ending August, 1897, were \$1,020,215.40. The largest receipts for any one month was during July, when they reached \$106,750.

Messrs. S. J. Lightbound, Louis Hall, John Smith and James O'Brien, of Huntsville, Ont., have passed the examination of the Ontario Association of Stationary Engineers and received their certificates.

It is stated that the capital stock of the Toronto Electric Light Company will be increased from \$1,400,000 to \$2,000,000. This increase is said to be necessary for the extension of plant and new buildings.

In Montreal recently Mr. Frederic Nicholls, of the Canadian General Electric Company, had a conference with Sir Charles Ross in reference to the water power scheme at Kootenay, B. C., for which his company is furnishing the electrical machinery. It is expected that early in November power from this source will be supplied to Rossland.

The annual meeting of the shareholders of the Great North-Western Telegraph Company of Canada, was held in Toronto on the 29th ultimo. The directors chosen were: H. P. Dwight, president; Adam Brown, vice-president; A. S. Irving, Richard Fuller, H. N. Baird, Hon. Wm. Macdougall, Charles A. Tinker, James Hedley and W. C. Matthews.



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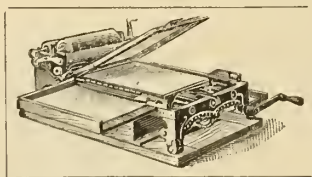
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The name of the Electrical Supply Company, of Hamilton, Limited, has been changed to the Electrical Power & Manufacturing Company, of Hamilton, Limited.

The effort to bring about an agreement between the Hamilton and Dundas Railway Company, and the Hamilton Street Railway Company, in relation to the former's running rights over the street railway in Hamilton and the supply of electric power, has been unsuccessful. The Hamilton and Dundas company is continuing its arrangements to change the present system to that of electricity, and to continue on its old tracks throughout the city.

According to professor Ebert, a German physicist, a single horse power would be sufficient to run 46,000,000 Pulu lamps of 16 candle power. This is a phosphorescent lamp constructed 15 years ago, and consists merely of a piece of mica painted with sulphide of calcium and subjected to the action of Cathode rays in a vacuum. Should it become possible to convert mechanical energy into light alone, a single man turning a crank could develop sufficient energy to light a whole city.

The announcement is made that D. MacLaughlin Therrell, the Southern electrician of the Postal Telegraph Company, whose headquarters are at Atlanta, Ga., has conceived a device by which he hopes to revolutionize long-distance telephoning. The invention, which combines the principles of the telephone and phonograph, has been publicly tested in a room at Atlanta, where renditions of vocal and instrumental music were transmitted through a resistance equal to that of 12,000 miles of wire, and were perfectly audible to all who had assembled to witness the experiment. Mr. Therrell's pet scheme is to have a telephone line across the Atlantic. This, he thinks, could be accomplished by having his repeaters located in bells at a distance of a thousand miles apart.

Mr. John McGill, of Kingston, son of the clerk of the county court, has invented a motor which he claims can be used in connection with steam, water power or compressed air, and that he can multiply the power of the usual steam engine ten times. "Take an engine," he says, "with a six inch cylinder. That is equal to about 28½ inches of steam space. To drive the piston one revolution at 90 pounds pressure will use 51,300 inches of steam. In my system it will take only 5,180 inches of steam to produce the same result, or take an engine with a five inch bore cylinder that is equal to 20 inches steam space. To run it at five pounds pressure, one revolution will require 2,000 inches of steam, and the power would be scarcely sufficient to overcome friction and set the engine in motion. In my system 910 inches of steam at five pounds pressure will yield a power of 24,000 pounds, equal to 7½ horse power." An ordinary turbine will scarcely move at 5 pounds per square inch, while with the new motor almost any amount of power can be obtained at that pressure, varying according to the size of the motor from, say, 25 to 100 horse power.

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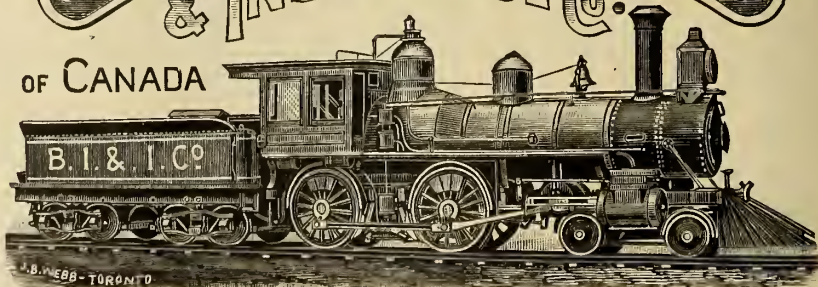
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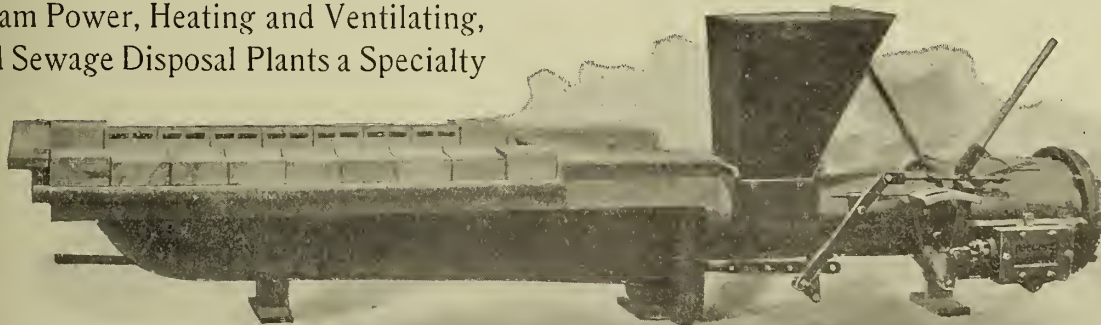
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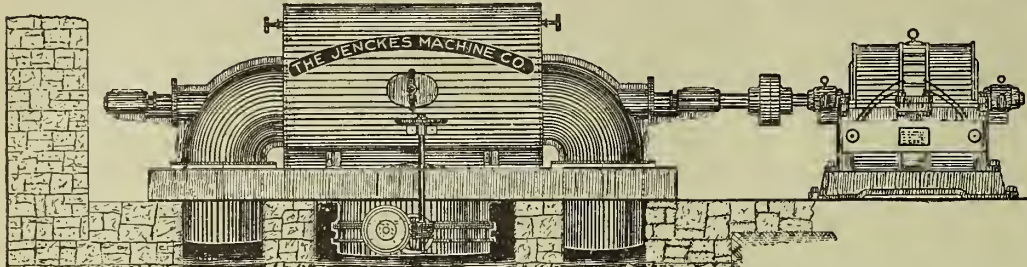
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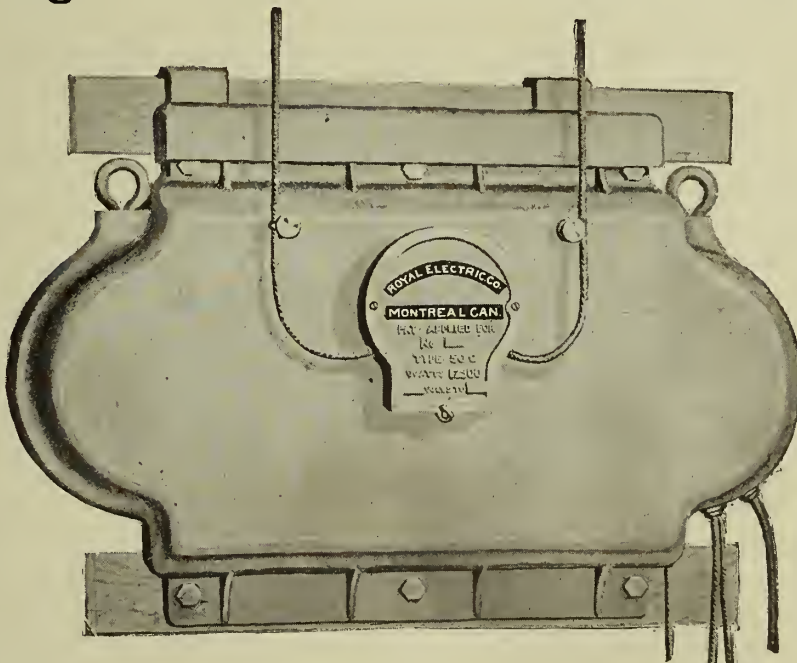
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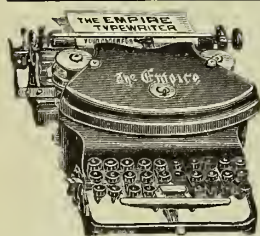
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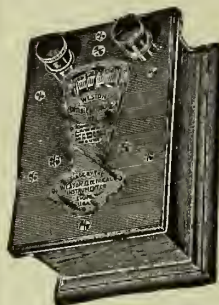
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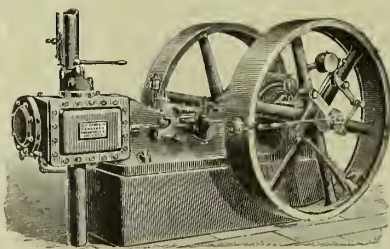
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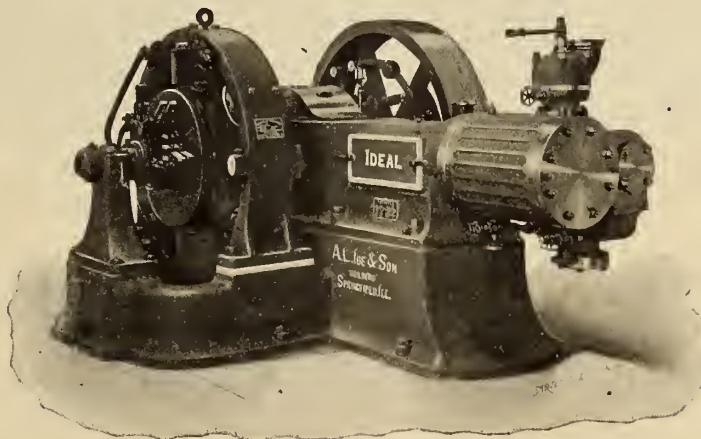
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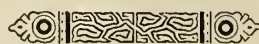
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VOL. VII.

NOVEMBER, 1897

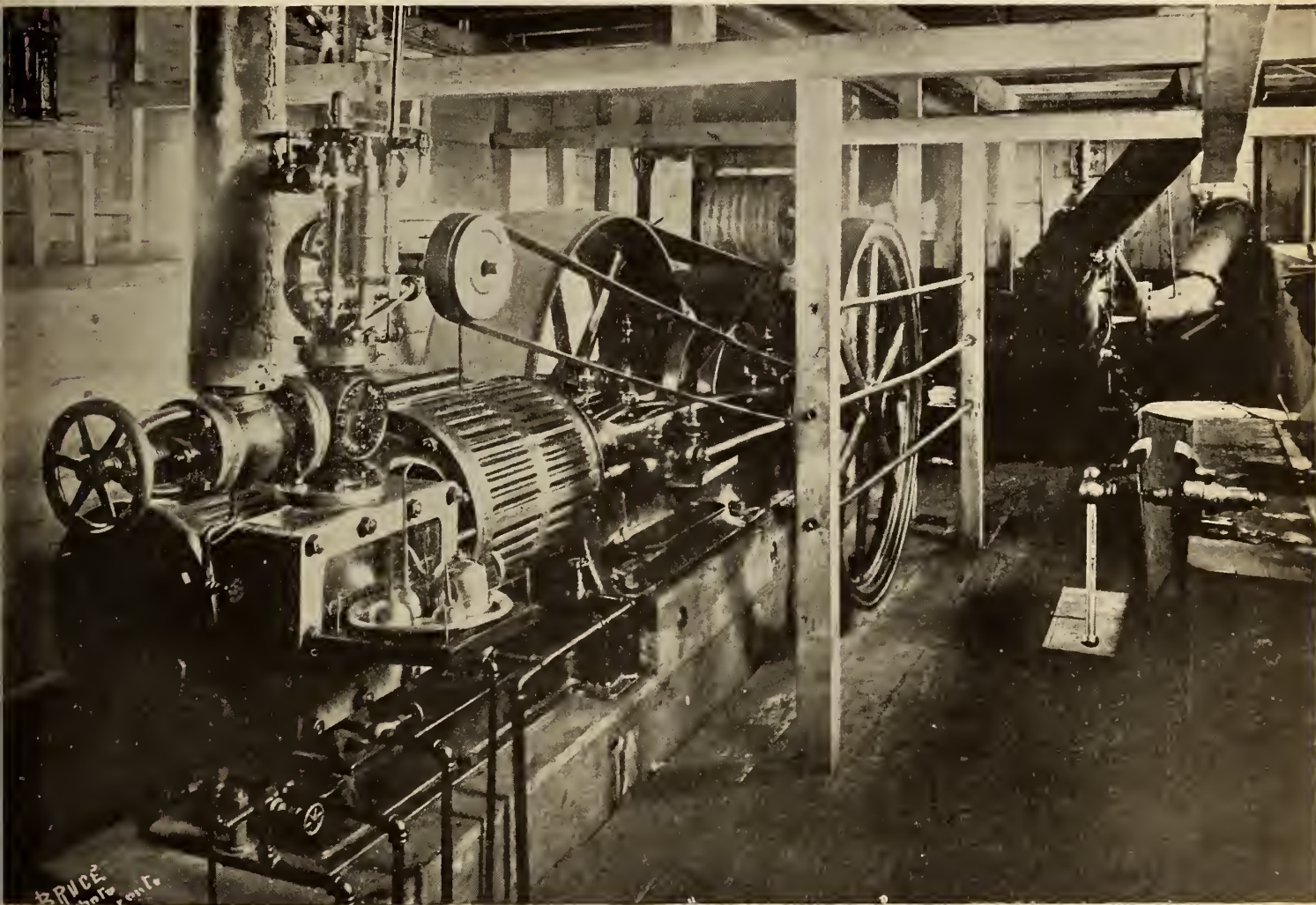
No. 11.

**HYDRAULIC DREDGE FOR THE CITY
OF TORONTO.**

LAST year the city council of Toronto made an appropriation of \$18,000 for the construction of an hydraulic dredge. The plans therefor were prepared by Mr. C. H. Rust, assistant city engineer, and the work of building awarded to Messrs. Medlar & Arnot. The dredge is capable of excavating to a depth of 16 feet, and is

hoisting and lowering the cutter frame and operating the swinging lines. The dredging pump is of the 12 inch centrifugal type.

In the engine room, a view of which is presented herewith, are to be found engines of the horizontal compound type, $10 \times 17 \times 15$ inch stroke, of ample proportions for high speed and continuous running, and designed to operate at a speed of 170 to 200 revolutions,



ENGINE ROOM OF HYDRAULIC DREDGE BUILT FOR THE CITY OF TORONTO.

fitted complete with all necessary machinery for manipulating the material and feeding the cutter head continuously and uniformly over the bottom. The hull is 90 feet long, 28 feet wide and 6 feet deep, with two bulk heads the entire length. The cutter frame is of steel, and the dredge is also fitted with a rotary steel cutter head, 48 inches in diameter at the base, 30 inches at outer end and 36 inches long.

A pair of duplex hoisting engines, 8×12 , with three drums and necessary attachments, are placed on the forward deck for the purpose of driving the cutter head,

the indicated horse power being from 75 to 125. The boiler is of the locomotive type, 72 inches diameter, 22 feet long, having 130 tubes of 3 inches diameter and 15 feet long. There is also an air pump condenser, $6 \times 10 \times 12$ in., and one duplex feeder pump with cylinders $5\frac{1}{4} \times 3\frac{1}{2} \times 6$ in. stroke.

Two spuds for holding the dredge in position and feeding it ahead are located at the stern of the dredge. These spuds are of oak 12×12 inches by 30 feet long. The contract provided that they should be operated by steam cylinders, but this was slightly altered, one hori-

zontal cylinder for feeding the dredge ahead by means of the stepping spud being constructed, and the hoisting being done by means of drums placed upon the lower deck immediately under the forward engine, and worked by a sprocket chain and two steel cables carried over the deck house to the stern of the dredge. The machinery, with the exception of the boiler, was constructed by the Skinner Engine Company, of Erie, Pa. The dredge was christened the "Daniel Lamb," after the chairman of the Board of Works for 1895, through whose efforts the appropriation for the work was made.

LONG-DISTANCE TRANSMISSION OF ELECTRICITY IN CANADA.

BUT a brief space of time has elapsed since it was considered impracticable to transmit electric power beyond the immediate surroundings of the generating station. There were to be found, at that time, persons who predicted that the transmission of electricity to any considerable distance would never be successfully accomplished, owing to the many difficulties to be overcome, such as loss of current, dangers of transmitting current at high voltage, etc. The developments of the last few years, however, have served to show how erroneous were these conclusions. To-day we find electricity being successfully transmitted nearly half a hundred miles. This has been rendered possible by the present high standard of efficiency of electrical apparatus, making it perfectly safe to transmit current at 20,000 volts, and reducing the loss in the line to a very low point.

It would appear that the long-distance transmission of electric power is yet in its initial stages of development. On all sides we hear of projected schemes, the promoters of which evidently feel encouraged by the success of late undertakings in this direction. Many of the valuable water powers in Canada promise to be utilized at an early date to supply light and power to adjacent cities, towns and villages.

The longest electrical power transmission yet undertaken in America is that of the Southern California Power Company, which purposes to deliver current at Los Angeles and Pasadena, a distance of eighty miles from the water power and generating station. The electrical machinery for this scheme is now being installed by the General Electric Company. The second longest transmission line is at Salt Lake City, the distance being thirty-six miles.

Coming nearer home, we find the water power of the Niagara Falls being utilized to supply power to the city of Buffalo, a distance of twenty-two miles. Then in Canada we have the transmission plant at Three Rivers, Que., a description of which appeared in the *ELECTRICAL NEWS* for October, and a less pretentious scheme at Trenton, Ont., both in successful operation. In British Columbia the West Kootenay Power and Light Company are developing the water power of the falls of the Kootenay river, the Canadian General Electric Company now being engaged in installing the electrical machinery. It is intended to develop 2,000 horse power immediately, the ultimate scope of the undertaking being to utilize the full power of the river, estimated at 10,000 h. p. The current will be carried, at 20,000 volts, to a substation at Rossland, where it will be reduced to 2,000 volts and delivered to motors for use in mining operations.

The latest scheme to take definite form is that of the Cataract Power Company, of Hamilton, Ont. This company, of which Hon. J. M. Gibson is president, was incorporated in the summer of 1896, having for its object the transmission of electric power from DeCew Falls to Hamilton, a distance of thirty-two miles. The matured plans of the company, however, show that the original intention of utilizing these falls has been abandoned. The power will be transmitted from a point near St. Catharines. The water power to be used is the overflow from the Welland Canal, which is led to the Niagara escarpment, where it will have a fall of about 260 feet. The length of the transmission line will be a little more than thirty miles.

The contract for the electrical machinery and line construction for this extensive undertaking was awarded a fortnight ago to the Royal Electric Company, of Montreal. This is among the largest contracts of the kind ever given in Canada, the price of dynamos alone being in the vicinity of \$200,000. The turbines will be supplied by the Stillwell, Bierce & Smith Vale Company, of Dayton, Ohio.

The scheme includes the construction of a canal from Allanburg to the cliffs at DeCew Falls, at the foot of which the power house will be built. This canal will be four and one-half miles in length, and from 40 to 45 feet wide, and will tap the Welland canal at Allanburg. The contract for the canal has been given to Angus McDonald & Company, who have already commenced work.

The initial installation will be for 3,000 horse power, but the plant will be designed for an ultimate capacity largely in excess of this amount. The current will be transmitted at 20,000 volts, the danger to operators in transmitting under this pressure being removed by a specially constructed switchboard.

The company have appointed Mr. H. R. Leyden, late of the Royal Electric Company, as manager. Mr. Leyden's experience in work of this character gives special fitness to his appointment to this position. It is expected that the enterprise will be completed early next spring, when the company will be in a position to supply light and power to the city of Hamilton. The entire work, including machinery, canal and distribution line, will, it is estimated, cost in the vicinity of half a million dollars, and must be regarded as a gratifying evidence of Canadian enterprise.

A full description of the engineering features of this important plant will be furnished in a future number of this journal.

The Perth Waterworks Company, Limited, which is installing the waterworks system for Perth, will use electric power for pumping. Their pump-house is located within the limits of the town of Perth, but the power which they intend using is about four miles away, on the Tay river. Here they are installing a water wheel and a 200 h.p. generator, which will, in addition to supplying the power for pumping purposes, furnish light and power for the town of Perth. The Waterworks Company has bought out the old Tay Electric Company, and will distribute light and power on their old circuits. The electrical machinery is being installed by the Royal Electric Company, who will use their S.K. C. two-phase system for this work. The pumping is to be done by means of a 75 h.p. motor belted directly to a triplex double-acting power pump, which pumps directly into the mains, no gravity system or stand-pipe being employed. The mains are equipped with a relief valve, so that the pressure can be maintained constant without varying the speed of the pump. The pump is arranged so as to be operated at two different speeds, in order to raise the supply of water and the pressure for fire purposes.

MR. D. H. KEELEY.

THE late F. N. Gisborne, who died in August, 1892, was succeeded as general superintendent of the Dominion Government Telegraph Service by Mr. D. H. Keeley, a portrait of whom appears on this page. Mr. Keeley was ably qualified for the position by his past experience in telegraph work, and since assuming his duties has given the utmost satisfaction to the department.

The subject of our sketch has been prominently connected with the Canadian Electrical Association, having contributed valuable papers thereto. He is a member of the Council and of the Medal Award Committee of the Canadian Society of Civil Engineers, in which office he may be said to stand as the representative of the electrical engineers' branch of the Society. He is also a member of the British Institute of Electrical Engineers.

The ELECTRICAL NEWS of March, 1895, contained an interesting article entitled "Our Government Telegraphs—Their Scope and Special Functions," which showed the extent of the government telegraph system and the territory served. At that time there were 2,451 miles of land lines and 206 miles of submarine cable,



MR. D. H. KEELEY.

with a total of 148 offices. These were distributed from British Columbia to Newfoundland. It will thus be seen how arduous and important are Mr. Keeley's duties, which continue to increase each year. In 1893 there were transmitted over government telegraph lines 41,550 messages. The expenditure upon the service was \$49,000, and the revenue collected amounted to a little over \$9,000.

The steamship "Newfield" is provided with the necessary appliances for picking up and relaying cables, and is made available for the work in the gulf when needed. The electrical work has been for years superintended by Mr. Keeley. When a break-down occurs in a cable electrical tests have usually to be made to determine the location of the trouble.

CANADIAN AGENT WANTED.

A LARGE European manufacturer of electrical machinery is desirous of securing a good Canadian representative, with a view of extending their business in this country. Any person wishing to act as such may obtain the name and address of the company at this office.

The management of the Montreal Cotton Mills Company at Valleyfield, Que., contemplates substituting electricity for coal to dry the cotton.

NEW PLANT FOR THE METHODIST BOOK-ROOM.

THE largest printing establishment probably in Canada is that owned by the Methodist church, and known as the Methodist Book & Publishing House, situated on Richmond street west, Toronto, and having a frontage also on Temperance street. The Richmond street building has 100 feet frontage and is four storeys high, exclusive of basement. Here is situated the retail department, editors' and others offices, board room, etc. The Temperance street front extends over 118 feet, on which is a six storey building, with basement, containing engine and boiler rooms, shipping offices, wholesale book departments, binding, folding and stereotyping rooms. Connected with these front buildings is another, consisting of four storeys, in which is contained the press room, composing room, book stock room, general office and store room.

The buildings are heated entirely by steam, the mechanical department by exhaust from the engines, and the front buildings, offices, etc., by the low pressure gravity system. The boiler and engine rooms of an establishment of this extent are necessarily large and attractive. In the boiler room are two 60 horse power boilers made interchangeable for high and low pressure. These are fed by a Northey steam pump. In the engine room are the engines, two Wheelocks, 60 and 90 h. p., connected to an underground shaft by large belts and arranged with friction clutch pulleys so that either engines or both may be used at any one time.

A new electric light plant has recently been installed for lighting the building, the electricity being generated by a $10\frac{1}{2} \times 10$ Ideal engine, direct connected to a 50 k. w. dynamo, manufactured by the Toronto Electric Motor Company, the engine and dynamo only occupying a space 6 by 8 feet. Current is generated for 650 incandescent lamps of 16 c. p. each, and from the machine there can be run as well, through motors, arc or incandescent lights. The armature of the generator is of the wave-wound type, with ventilated core, and so constructed that no wire passes over the ends. Consequently no dust or dirt is allowed to accumulate. The crown is of heavy iron, with the laminated poles cast in so that the magnetic current is perfect. Beside the generator stands a marble switch-board, with instruments complete, the whole making an up-to-date and efficient plant. The establishment is protected against fire by two large stand-pipes running from cellar to roof, with hose on each flat attached and ready for use.

Mr. G. C. Mooring has entire charge of the steam plant and machinery, having been employed by the firm for over eight years. He is popular with his brother engineers, and was a charter member of Toronto No. 1, C. A. S. E., of which association he is now president.

Mr. Wm. T. Bonner, formerly general agent for Canada for the Babcox & Wilcox Company, has recently returned from a trip abroad, and will take up his residence in Montreal again, as manager for Canada for Babcock & Wilcox, Limited, of London and Glasgow. Temporary quarters have been taken in the Board of Trade Building, but as soon as the decorators and furnishers can complete their work, the Babcock & Wilcox offices will be located in the Mechanics' Institute building, at the corner of St. James and St. Peter streets. A full line of samples and models of the Babcock & Wilcox water tube boilers and accessories will be exhibited, and every facility and convenience placed at the disposition of the engineers and steam-users, to give them a thorough understanding of the merits of the Babcock & Wilcox Company's goods.

DISCOVERIES OF MICHAEL FARADAY.

SOME interesting particulars of the life of Michael Faraday, the great electrical discoverer, are furnished by the American Electrician, to whom we are also indebted for the accompanying portrait.

Michael Faraday, born 1791, died 1867, the son of a poor mechanic, was, at the age of thirteen years, apprenticed to a bookseller. He worked for some years as a bookbinder, afterwards securing a position with Sir Humphrey Davy in the Royal Institution, where his great career was commenced. A diligent student, and always seeking information, he attended lectures on natural philosophy and other subjects, which created a strong desire in him to engage in scientific work. He was first appointed laboratory assistant in 1813, and his first discoveries were made seven years later.

In 1821, Woolaston conducted some experiments in the laboratory of the Royal Institute to realize an idea he had formed from Ampere's discoveries, that a conductor carrying a current could be made to rotate about the pole of a magnet and vice versa. In this he was unsuccessful, but Faraday, taking up the subject, finally succeeded in obtaining such rotation. The apparatus thus constructed by Faraday was the first electric motor; ten years later he constructed the first transformer and also the first dynamo—the Faraday disk.

In the period between 1821 and 1831, among other discoveries made in chemistry by Faraday was that of the element chlorine. He became director of the Royal Institution laboratory, and in 1831 made his great discovery of electro-magnetic induction, which turned his mind definitely toward pure science as the sole object of his life, and thenceforth he permitted nothing to distract his attention from it. On August 29 of the same year he succeeded in making the greatest discovery of all time and laying the foundation upon which rests the great electrical development of the past 25 years. It was that electricity was capable of being produced by magnetism. The apparatus used consisted of an iron ring wound with two coils of bare wire, one about 72 feet and the other 60 feet long, the turns being separated by twine and the layers by calico. The longer coil was connected to a primary battery, and a loop of the other passed over a magnetic needle. When the battery circuit was made or broken, the needle was deflected one way or the other, by the induced current set up. This apparatus was the first transformer, combining every principle of the modern apparatus known by that name.

These discoveries followed: September 24, that a current was induced in wire coiled on an iron cylinder when a magnet was approached to the latter; Oct. 1, that if a current passed through one of two adjacent coils on a block of wood was made or broken, a momentary current flowed in the closed circuit of the other

coil; Oct. 17, that current could be generated in a coil by merely inserting and removing a magnet.

On October 28th Faraday made the first dynamo by revolving a disk between the poles of a magnet; when one end of the wire of a closed circuit was pressed against the circumference of the disk and the other against its axis, a continuous current was produced.

On the final day of his great experiments, he found that by merely passing one side of a closed circuit between the poles of a magnet, a momentary current was induced in it. To explain all of the various phenomena observed, he conceived the idea of lines of magnetic force proceeding from a magnet, or surrounding a conductor carrying current; that when a conductor cuts such lines an E. M. F. is generated in it; and that the amount of this E. M. F. is proportional to the number of lines cut in a given time.

It should here be remarked that Henry in August of 1831, independently discovered electromagnetic induction, his experiment being very similar to the first successful experiment of Faraday. He did not, however, follow it up.

Two other epoch-making discoveries are associated with Faraday's name—the laws of chemical decomposition and the magnetic rotation of the plane of polarization of light.

After a magnificent series of experiments he laid down the law known as Faraday's law, which formulates the relation between the strength of current and amount of any substance deposited by it. He also found that if a ray of light was passed through certain media, and if these media were placed in a field of force, the plane of polarization was changed, being rotated through a definite angle for each substance and each strength of

field. This principle has recently been used by Crehore and Squier in the construction of a chronoscope and in a system of rapid telegraphy. This is only some of the discoveries made by Faraday.



MICHAEL FARADAY.

It is expected that there will be keen competition between Canadian and United States firms for supplying the equipment of the proposed electric railway at Kingston, Jamaica. Messrs. Wm. McKenzie and James Ross are the chief promoters of this scheme.

A contract was concluded a couple of months ago between the Southern California Power Company and the General Electric Company for the transmission of the power of the river running through the Santa Ana Canyon to Los Angeles and Pasadena, Cal., a distance of 80 miles. The amount of power to be transmitted at first is 4,000 horse power. The station will be located in the Santa Ana Canyon, 12 miles from Redlands and about 80 miles from the towns in which the electric power will be utilized. The water will be taken from the river to canal, flume and tunnel along the side of the canyon. Here it will be led into a pipe line 2,200 feet long, giving what will be equivalent to a vertical fall of 750 feet. This transmission will be the longest electrical power transmission yet undertaken. At present the longest is at Salt Lake City, where power is transmitted a distance of 36 miles.

MUNICIPAL LIGHTING PLANT.

THE town of Orillia, Ont., operates its electric system in connection with the waterworks plant. The management of the plant is vested in a board selected from the town council, Mr. J. S. Millan being chairman. Mr. P. Ritchie is engineer-in-charge, and under him are three assistants.

The plant is situated near the lake, where condensing water is easily obtainable. The G. T. R. tracks pass alongside the power house, by which means the fuel supply is easily obtained. Nature supplies an abundance of pure spring water into a partly submerged tank, with a capacity of 33,000 gallons. These springs are situated on Muskoka Hill, an elevation in the northern part of the town, and the water gravitates to the tank.

Besides this tank there is a stand-pipe three-quarters of a mile away, with from 100 to 120 pounds pressure. There is also a reservoir on Peter street with a capacity of 250,000 gallons.

Forty-five arc lamps light the streets, and 2,300 incandescent lamps are installed for public and private lighting.

The power house is a substantial brick structure, divided into two compartments—one for engines, dynamos, etc., the other for the boilers and pumps. The dynamo room is 35 x 40 ft., and presents a neat appearance. Two Goldie & McCulloch 100 h.p. cut-off condensing engines, harnessed to a line of shafting which extends across one end of the room, operate the machines. Four clutches by the same makers are on the shafting, so that one or all the machines may be worked together, or separately. These machines are two 1,000 k.w. Thomson-Houston alternators, and three Ball arc machines of 25 lamps each, each lamp being of 2,000 c.p.

In the centre is the large steam pump built by McQuillan & Co., of Toronto, capable of pumping 900 gallons of water per hour and throwing 19 gallons per stroke, with 50 strokes to the minute. A spare pump, of Northey make, with a capacity of 200 gallons per minute, is kept in case of emergency. A Goldie & McCulloch condenser in the basement, fed by a Northey pump, condenses for the engines.

The steam main from the boilers is six inches in diameter, with five-inch feeds to the engines and four-inch to the pumps.

At the end opposite the shafting is a large C. G. E. skeleton switchboard, fully equipped, placed half-way up the wall, and reached by iron stairs leading to an iron platform surrounded by brass railings. This is claimed to be a great improvement over the usual manner of arranging switchboards, as the operator is right over his work and has view of all the machines, engines and pumps.

The ceiling of the building is of matched lumber and nicely painted, setting off the bright dynamo room. The boiler room is smaller than the dynamo room, but there is space left for an increase of plant. Two boilers fed by a double-plunger pump and a steam pump generate steam for the two engines. The plunger pump is operated by a belt from one of the engines on the dynamo.

One boiler of 100 h.p. is made by Goldie & McCulloch Co., the other by Perkins & Co., of Toronto.

The plant, as a whole, is very creditable, and few better are found in Ontario.

CORRESPONDENCE

THE PROPOSED STEAM BOILERS ACT.

DARTMOUTH, NOVA SCOTIA, Oct. 11th, 1897.

To the Editor of the CANADIAN ELECTRICAL NEWS.

SIR,—In reading the bill called "The Steam Boilers Act," as it appeared in your issue of June, that was put before the Dominion parliament last session, by the Canadian and Ontario Associations of Stationary Engineers, it appeared to me that the fifth clause or section as it reads, seriously impairs the usefulness of the whole Bill from an engineer's standpoint.

For the benefit of those who may not have read the Bill I will, with your permission, quote the above-mentioned clause:

"Every person who, at date of the the passing of this act, has been for two years engaged in the operation of steam boilers, upon producing a certificate of his uniform good conduct and sobriety from the owners by whom he has been employed during the said period, and also from some responsible person not connected with the business of such owners and a resident in the municipality or in each of the municipalities in which such boilers have been so operated, or a holder of a certificate from any incorporated body or from any province, shall be entitled, upon making an application to the chairman of the board on or before the first day of January, 189 , and upon payment of dollars to the chairman, to receive a certificate of qualification and to be registered under the provisions of this act."

Now the fact that a man has had two years experience in charge of a steam plant is certainly no guarantee that he is qualified to operate steam boilers and engines safely and with intelligence, even though his character may be the best, and the fact of his obtaining a certificate without an examination won't make him so. I can call to mind men who have been feeding fuel to the furnace and twisting the throttle valve and squirting oil for years, but if you were to ask them what is the safe working pressures of their boilers, or the tensile strength of the plate therein, they would look at you in astonishment—they never heard of such a thing. Will it be fair to honest and studious engineers to grant such men certificates? Will it be fair to the public? If I understand the said clause correctly it will not.

Brother engineers, let us have an act that will be a credit as well as a benefit to ourselves—an act that will be a guarantee to the public that the men who are in charge of such terrible agents of destruction (when carelessly and ignorantly handled) are men who have been duly examined and have been found well fit to fill the positions they hold.

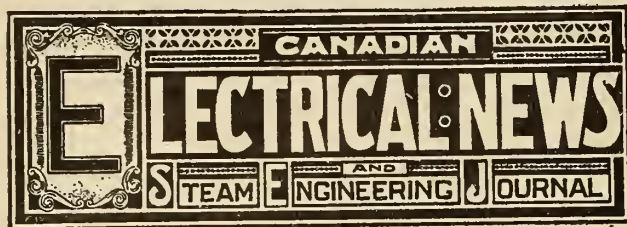
Under a proper license law, every man, no matter how many years of experience he has had, should undergo an examination and receive a certificate according to his fitness, if he be entitled to one. Also, what size plant a man holding a certain class certificate will be allowed to operate, should be clearly stated.

We all know, once an act becomes law, what a job it is to have it amended. I hope we will hear from other engineers on the subject. Thanking you for space, I remain

Yours truly,

ACADIAN ENGINEER.

The Strathroy Electric Light Company, Limited, are adding an incandescent lighting equipment to their new arc lighting plant and have placed their order with the Canadian General Electric Company for a 30 kilowatt standard single phase alternator of the company's latest type.



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Correspondence is invited upon all topics legitimately coming within the scope of this journal.

The "Canadian Electrical News" has been appointed the official paper of the Canadian Electrical Association.

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Apparatus for Improving Electrical Supply.

IN the continent of Europe and in the United States engineers are devoting their energies towards the improving

of electrical supply, not only for lighting, but also for power, heating, electrolytic and railway services, and the last two years have seen great changes, and great progress in the methods of central station operation and in the general economies of electric lighting and power. In Germany, where some of the best and most prosperous electrical central stations are to be found, they use storage batteries in connection with nearly every generating plant, and in Great Britain they have evolved and taken rapid hold of two very important improvements, viz., the 220 volt lamp and the alternating current rectifier for arc circuits. Is there a rectifier in the whole of Canada? Is there one individual central station in the Dominion that has manifested sufficient regard for its own interests as to investigate the merits of a storage battery auxiliary? Has anyone ever asked for a 220 volt lamp? The matter rests with the public. Let them insist on improved, up-to-date apparatus, and be willing to pay reasonable prices for it, and the manufacturing companies will meet the demand.

Method of Charging For Current.

A MATTER that is receiving the attention of wide awake managers in Great Britain, and is even spreading to

America, is the method of charging for current. It seems open to question whether a meter rate is always the best way. There seems to be a limit of population below which a "flat rate," while theoretically imperfect, is commercially the better way, and above this limit the flat rate can be applied in certain cases where the rate of current consumption is regular and the hours certain, while meter rate is applied to the customers. But even then it can be reasonably argued that there should be graduations in the meter charges, corresponding to the duration of the time during which current is supplied. Assume for purposes of illustration a 1000 light plant, with current supplied by meter, and take two consumers; the first burns thirty 60 watt lamps for 10 hours, consuming 18,000 watt hours, the second burns one hundred 60 watt lamps for three hours, also consuming 18,000 watt hours. While their consumption has been the same and they pay the same, still it is evident that the central station has to keep one-tenth of the capacity of the machine for the second consumer, but only one-thirtieth for the other. It is plain, therefore, that the first consumer is the more profitable, and others like him should be encouraged. In the smaller plants, however, it is at least open to question whether the expense of purchase and up-keep of meters would repay their

use. No doubt the business done could thereby be extended somewhat, but the continual testing of meters and questioning of their accuracy would impose a burden hard to be borne.

The Paris Exposition.

THE great exposition that is to take place in Paris, France, in 1900, should not be lost sight of by Canadians, and by Canadian manufacturers in particular. The time is distant a little less than three years, and it is now none too early to begin preparations for making a creditable display of Canadian products and manufactures. We are pleased to observe that a deputation from Montreal has drawn the attention of the Dominion government to the matter, and that there is a strong probability of assistance being received from this source. But in addition to a Dominion grant, it would seem fitting that each provincial government should assist to secure the advantages which are certain to accrue to us from a commercial standpoint by having Canada properly represented at this exposition. This year the Dominion of Canada has been advertised abroad as never before, and the benefits therefrom have already commenced to be realized, as shown by enquiries received by manufacturers. Having thus made a start we should seize every opportunity to further extend our trade relations, and where a foothold is once secured the quality of our manufactures may be relied on to keep the market.

Municipal Control of Electric Lighting.

THE ratepayers of the city of Toronto will shortly be called upon to decide one of the most important questions ever submitted to a popular vote. They will be asked to declare themselves for or against the municipal control of electric lighting. The subject is receiving much attention from the public press, and, as is usual with questions of this character, widely varying opinions are expressed. The Globe, in a leader in its issue of November 5th, states that according to statistics over two hundred American cities have experimented with public electric lighting plants, and follows this with some figures showing the cost per lamp per annum in several of the cities where municipal control obtains. The figures as given, unaccompanied by any particulars of the conditions surrounding the operation of the plants, are evidently intended as an argument in favor of municipal control. But only one side of the case is presented. Of the two hundred cities that have thus experimented, no information is given regarding the plants that have proven an entire failure under municipal management, but half a dozen or more plants are selected which evidently suited the requirements of the article. The city of Detroit is pointed to as having greatly reduced the cost of its lighting by installing a public plant. A fair comparison may be made between the cities of Detroit and Toronto, the population being about equal. We have in our possession the annual report of the Detroit municipal lighting plant for the year ending June 30th, 1897. This statement shows that the city operates 1,600 arc lamps of 2,000 c. p. each, and that the actual cash outlay last year was \$64.19 per lamp, exclusive of depreciation of plant, interest on outlay, or taxes which would otherwise be paid to the city. Allowing for these, the report gives the total cost per lamp as \$89.42, as compared with \$87.40 the previous year. But in the item of depreciation only the boilers are taken into consideration, on the ground that as the balance of the

plant was kept in the best possible condition of repair, the cost of depreciation would be too small to be worthy of consideration. That this is an unfair comparison every reasonable person will admit. Careful attention may prolong the life of the machinery, but it cannot prevent it from ultimately wearing out. Furthermore, no allowance is made in the report for insurance. Placing the depreciation and insurance at the very lowest estimate of 3 per cent., the cost per lamp per annum would be \$97.26. Let us see how these conditions compare with those in Toronto. We are supplied with about 1,200 arc lamps of same capacity as those in Detroit at \$74 per lamp per year, a difference of \$15 as compared with the cost of lighting in Detroit as given in the report, and of \$23 if depreciation and insurance are taken into account. Then there is the fact that the cost of fuel and supplies is less in Detroit than in Toronto, a very important consideration. It has been pointed out that Detroit is now producing its light at a lower cost than that paid by private contract previous to the installation of the plant. This is not due to the economy of a civic plant, but rather to improved machinery, cheaper supplies and other considerations. As proof of this stands the fact that the cost of electric light to the city of Toronto by contract has also been greatly reduced within the last few years. Now, as to the first cost of an electric plant of sufficient capacity for the present requirements of Toronto, the figures given in the Detroit report show an investment of nearly three-quarters of a million dollars, and that each arc lamp cost \$337.88. These are considerations which should be carefully weighed by the ratepayers. They will do well to be guided by the results of experience rather than by theory.

Extraction of Ore By Electricity.

THE mining world has been watching with much interest the success of the experiments by Mr. Edison to recover by an electrical process the iron contained in low grade ores. It has long been known that by means of magnetism the extraction of iron ore could be accomplished, but the problem to be solved was the perfecting of a process which would render the treatment of even the leanest deposits commercially feasible. To this end Mr. Edison has in a measure concentrated his efforts, and it would now seem that after a large expenditure of money he is to be rewarded by success. His experiments have been carried on in New Jersey, where about \$3,000,000 has been expended in plant. The process by which iron mining promises to be revolutionized consists in applying the principle of the magnet, by which the little black particles of ore are drawn from the pulverized rock. The powder is allowed to fall in close proximity to electric magnets, which deflect the iron to one side and the non-metallic matter falls to the other side by gravity, the entire process being automatic. This is one of the greatest of Mr. Edison's many achievements, and one which will undoubtedly have a far reaching effect upon the iron industry throughout the world. To Canada it is likely to prove of great benefit. We have abundance of iron ore deposits, but the difficulty in the past has resulted from the absence of cheap coal in close proximity to the mines. Thus the advantages of the application of electricity for ore extraction is at once apparent. That he has finally reached the goal of success must be a source of gratification to all persons as well as to Mr. Edison.

LIGHT, A BRANCH OF ELECTRICITY.

By C. A. CHANT, B.A..

THE most distinguishing feature of the science of our age has been the establishing of comprehensive general principles as results from closely-reasoned processes of induction. Any branch of science is chosen, and after analyzing its almost countless phenomena in order to discover as well as possible their true nature, the reverse process is taken, objects with analogous properties are classed together, these classes are again co-ordinated, until at last we reach a grand unity, held together by a single broad principle.

Illustrations will at once suggest themselves. In biology we have the great principle of evolution. Many gaps, no doubt still exist in a complete statement of it, but the general theory itself is so based on hard experimental fact, that it must be true in its general outline at least. In chemistry, although the non-predictable nature of many of its combinations gives to it a certain arbitrary or empirical aspect, has as its fundamental ground-work the principle of the conservation of matter, that is, matter cannot be created or destroyed, but only transformed from one shape to another. From the time that this was first solidly established a little over a hundred years ago, the science has continued to grow in a healthy way. Of late it has become somewhat more physical in nature, due to its employment of physical methods and working on the border line between physics and chemistry. In physics we have the grand principle of the conservation of energy, a fitting complement to the base-principle of chemistry.

These are probably the greatest illustrations of the statement I have made, but there is another, not quite so wide in its nature, of which I wish to speak, namely, of the intimate relation between radiant heat, light and electricity which has been triumphantly demonstrated in very recent years, and which is usually known as the electro-magnetic theory of light.

Since this theory has come into prominence so lately, many are inclined, on learning of it, to think of it as a purely recent production. But such is not the case. No great scientific principle ever sprang from the mind of man full-grown. As a matter of fact, the seeds of the theory were sown more than half a century ago by that prince of experimental philosophers, Michael Faraday; the plant was cultivated and brought into bloom

by Clerk Maxwell as much as thirty years ago; while, led by Hertz, the world has plucked the ready fruit during the last decade. A discovery may be flashed over the world in a day, for instance, the Roentgen X rays; but almost two years have passed and we have scarcely begun to learn their inner nature, by which alone we can rationally classify them.

I shall attempt to explain in a few words how light has come to be regarded as included in electricity.

We are all familiar with the old experiment of rubbing sealing wax on a woollen coat-sleeve and then picking up bits of paper. By rubbing we are said to charge the wax with electricity. Electrical machines, with glass plates, are more efficient in producing a similar effect. Suppose we suspend two metal balls by means of silk thread (Fig 1), and then charge each of these by means of an electrical machine. It has been

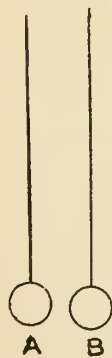


FIG. 1.

found that there is then a force exerted between A and B, variable with the distance between them. In this case they mutually repel each other. This fact was an old, old one; but Faraday conceived that the action of A on B must have something to do with the space between them.

To test this, he filled the space between the two attracting or repelling bodies with various substances, such as paraffine, petroleum, etc.; and, just as he suspected, the mutual action was thereby much altered. He therefore concluded that this "electric force" was handed on from one body to the other by means of something between them. But this force is exerted even in a vacuum, and so the handing-on medium must be quite distinct from ordinary matter.

In a similar way let us consider two magnets (Fig. 2)

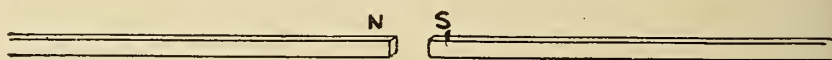


FIG. 2.

with two poles N and S, near together, but so long that the other poles may be neglected in our reasoning. There is an attraction between N and S. If we immerse them in water, or oil, the change in this attraction is so slight that we cannot detect it. But if we could surround the magnets in an atmosphere of iron, this force would be very greatly diminished. As before, the action depends on what is between the two poles, and so magnetic force is also to be considered as being handed on from one body to the other by means of something in the space between.

But if a body transmits through its mass a motion given at one point, time is required to do it. For instance, sound takes time to pass through the air, water, iron, or any other substance. The question is naturally suggested, With what speed are the electric and magnetic forces transmitted from one body to another? Faraday tried to measure this for magnetic force. Indeed, Lord Kelvin tells us that the very last time he saw him at work in the Royal Institution he was down in the basement, far from disturbance, endeavoring to determine the time required for the magnetic action to travel from an electro-magnet to a magnetized needle many yards away; but the attempt failed, no time was observed.

Maxwell followed, and on applying his great mathematical ability, he succeeded in deducing a theoretical value for this speed, and this value when calculated turned out to be extraordinarily near the velocity of light—so near, indeed, that he was led to believe they were really identical.

Now, for many years the wave theory of light has been accepted as true, and this theory requires us to believe that light action is handed on from one point to another by a medium pervading all space, known as the ether. At once we grasp at the suggestion that this ether is the very medium required for the transmission of electrical and magnetic effects, and when Maxwell found that the speed of transmission in each case is the same—that of the velocity of light, 186,000 miles per second—he considered this suggestion practically demonstrated to be true. He then propounded the theory that the disturbance known to us as light is really electro-magnetic in its nature. Very recently the actual velocity of the transmission of electric and magnetic actions has been measured, the same as the velocity of light. If, then, light is an electro-magnetic

phenomenon, optics must be but a branch of the imperial science of electricity.

Again, energy, in the form of light, is transmitted in the ether by means of undulations or waves; electrical energy should likewise be transmitted through the same ether in waves. We are well acquainted with methods of generating and of detecting light waves; how can we generate and then detect electric waves? Hertz answered this question. One of his radiators, or generators of electrical waves, is illustrated in Fig. 3.

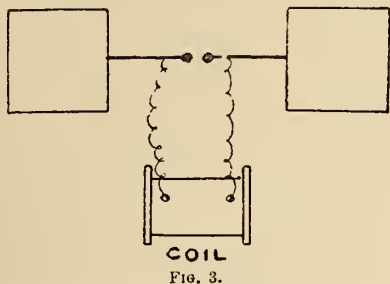


FIG. 3.

It consists of two sheets of metal from which run out rods ending in knobs near together. If, now, this be joined to an induction coil, and the coil be put in action, sparks will pass between the knobs, and every time a spark passes, the ether about the metal will be agitated, and the disturbance thus caused will spread in every direction, just as light radiates from a candle.

But how shall we detect these waves? The eye, which is so marvellously sensitive to light waves, is entirely unaffected by these longer ones. But Hertz discovered that by taking a wire with a knob on each end and bending it round as in Fig. 4, he could use this for his purpose. Holding it almost anywhere near the radiator, small sparks would pass between the knobs, caused by the electric energy transmitted to it. By suitable arrangements sparks could be seen more than twelve yards away. By means of such radiators and receivers (or detectors), Hertz investigated the nature of the electric radiation, and found that it was in waves which, he showed, possess all the ordinary properties of light, i. e., they both follow the same physical laws.

Since these researches (1887-1890) radiators and re-



FIG. 4.

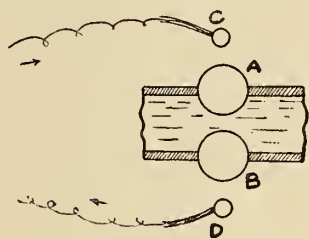


FIG. 5.

ceivers of many different forms have been devised to more easily illustrate the discovery of Hertz. A very convenient form of radiator, due to Righi, Professor of Physics in the University of Bologna, is illustrated in Fig. 5. A and B are two metal spheres fitting tightly in the centres of two ebonite discs which form the top and bottom of a cylinder with flexible walls. This cylinder is filled with vaseline oil, so that half of each ball is in the oil. The knobs C and D are connected to the coil, which, when excited, causes sparks to pass from C to A and D to B, and then from A to B through the oil. By this means electric waves are sent out in every direction. If the cylinder be placed in a parabolic reflector (of sheet metal) the radiation may be projected forward in a single direction, like that from a locomotive headlight.

One of the most convenient receivers is what Lodge has termed a "coherer." It consists simply of a glass tube nearly filled with metallic turnings or filings (Fig. 6.) When this is placed in the path of electric waves,

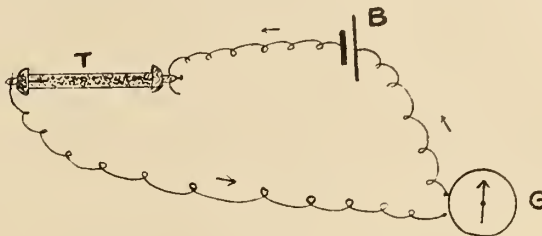


FIG. 6.

the bits of metal seem to cohere, so that an electric current can pass through them more freely. The arrangement to show this is given in Fig 6. T is the tube, and pieces of wire run into each end and terminate amongst the turnings. B is a voltaic battery, and G is a galvanometer for measuring the electric current. These are joined as in the figure. Usually the resistance of T is so great that no appreciable current flows and the galvanometer is undeflected, but as soon as the electric waves get amongst these turnings they "cohere," the resistance falls, a current passes, and round goes the needle! By simply tapping the tube the coherence disappears and all is ready for another trial. This tube may also be enclosed in a parabolic reflector, and thus made more sensitive in certain directions. Using these instruments the various laws of optics can be verified for electric waves.

To show reflexion, let us arrange the radiation and receiver as A, B in Fig. 7. The radiation goes out

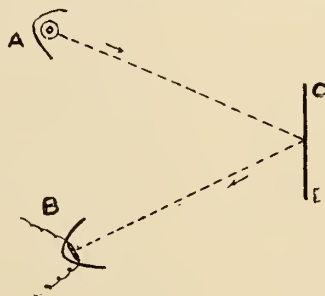


FIG. 7.

from A in the direction indicated by the arrow, and if a metal sheet (tin foil on a board will do) be held at C D the beam is reflected toward B and will be indicated on the galvanometer.

Refraction is very interesting. To show this we place the radiator and receiver as shown in Fig. 8. The receiver is little affected on working the radiator; but on putting a prism of some good non-conductor, such as paraffine or pitch, at C D E, the galvanometer at

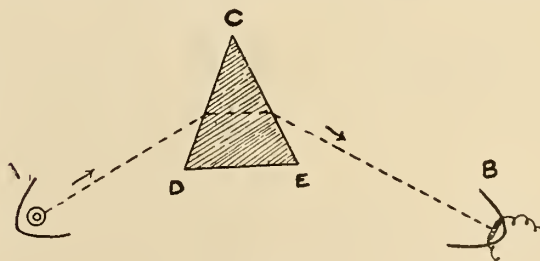


FIG. 8.

once registers a strong action. The radiation is bent from its original direction by the prism C D E. Hertz's original experiment is a famous one. His radiator and receiver were of great size, and the section of the prism made of hard pitch was an isosceles triangle, having a

side of nearly four feet and refracting angle, C, of 30 degrees. The height of the prism was nearly five feet, and it weighed over 1,300 pounds.

Experiments on total reflexion, double refraction, polarization, and other well-known optical effects have been successfully made, thus completely identifying electric and light waves.

Great interest has been shown during the last year or two in the experiments made by Preece and Marconi on signalling without wires. The former is chief of the British Postal Telegraph, and the latter is a young Italian who showed some of his apparatus to Preece and secured his co-operation in the experiments. The method used by these men is precisely that described above—by means of electric waves.

A general diagram of the apparatus is given in Fig. 9, the upper part showing the transmitting, the lower part the receiving apparatus. The radiator is the same as that illustrated in Fig. 5. Its two spheres, A, B, are of solid brass, four inches in diameter, each projecting into an enclosure filled with oil. The induction coil, shown in Fig. 9, which produces the spark discharge between the spheres and thus excites the electric waves,

is a very powerful one, capable of giving a twenty-inch spark. K is a key for starting and stopping the coil.

Marconi's receiver is a slight modification of that in Fig. 6. It consists of a small glass tube $1\frac{3}{4}$ inches long, into which two silver polepieces are tightly fitted, the ends being about 1-50th of an inch apart. This narrow space between the ends is filled with a mixture of nickel and silver filings mixed with a trace of mercury. The tube is then pretty well exhausted of air and sealed up. Thus constructed the receiver is very sensitive. From each end of the tube extends metallic wings, W, W, which assist in collecting the radiation, in 'tuning' the receiver to the radiator, and perhaps in other ways not yet explained.

In place of the galvanometer in Fig. 6, is put a sensitive telegraph relay, which "clicks" when the waves reach the receiver tube. To "decohere" the

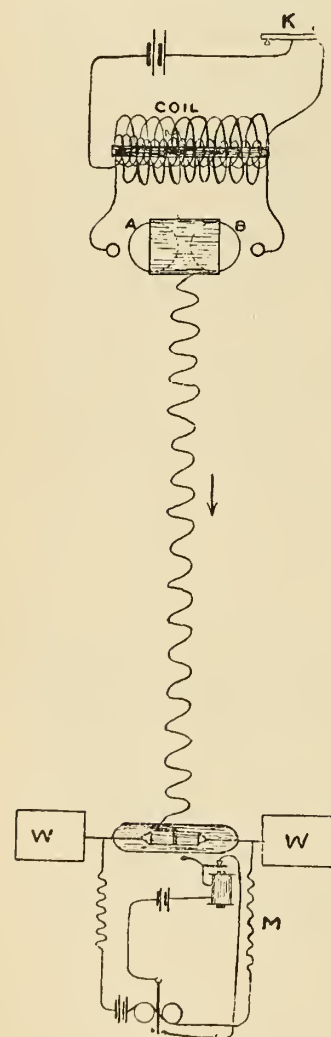


FIG. 9.

particles in the tube and make it ready for a second signal, the current which works the sounder is also arranged to work a small hammer (shown in Fig. 9), which taps the tube and produces the desired effect.

For short distances, where nothing obstructs the passage of the waves to the receiver, no great difficulty is experienced in transmitting signals; but when the space to be traversed is great some new arrangement is required. Sometimes the radiator or receiver is raised

to a sufficient height, or the expedient exhibited in Fig. 10 is adopted. Here the wing W, W are removed and an aluminum wire runs up from the receiver to the kite. This wire has the power of 'picking up' the waves and sending on the disturbance to the receiving tube, and thus producing the signal.

Using these two instruments, excellent signals have been transmitted between Penarth and Brean Down,

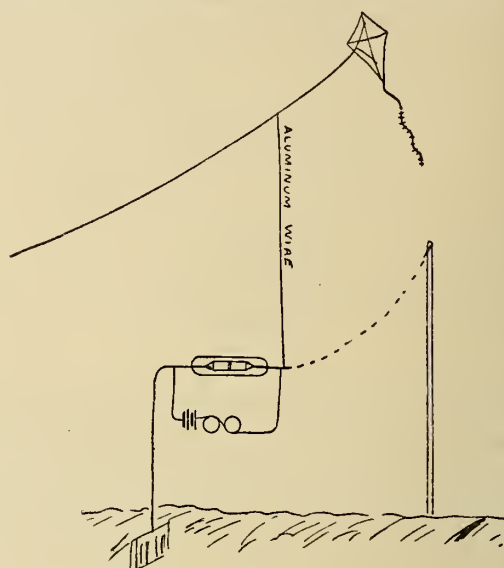


FIG. 10.

near Weston-super-Mare, across the Bristol Channel, a distance of nearly nine miles.

Marconi found that his receiver responded even when enclosed in a perfectly tight metallic box, and this fact has given rise to the rumor that he could blow up an ironclad. The difficulty which might be experienced in putting such an apparatus into the powder magazine of an enemy's ship seems to have been entirely ignored.—*Methodist Magazine and Review*.

ONTARIO LIGHTING PLANTS.

MARKHAM ELECTRIC LIGHT PLANT.

This plant, owned by Mr. W. J. Fletcher, of Alliston, was installed in July, 1896, and is managed by Mr. Wm. Trueman. The plant consists of a Royal 500 light generator, with skeleton switchboard, furnished with Royal instruments. Power is supplied by a 50 h. p. Wheelock engine and a 60 h. p. boiler. There are installed at present about 400 incandescent lights, and a contract with the town calls for thirty-one 32 c. p. street incandescent lamps.

CANNINGTON ELECTRIC LIGHT PLANT.

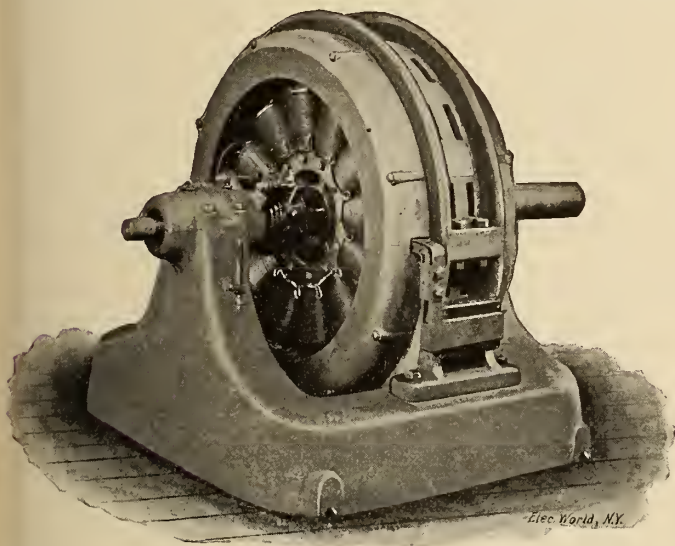
The lighting plant at Cannington, Ont., is owned and controlled by Messrs. Dobson & Son. It is situated in a substantial brick power house, adjoining the firm's woollen mills. Besides the arc and incandescent system, this firm have just installed a 25 h. p. Weston dynamo to furnish power to a carriage factory, printing office and bakery in the town. In addition to this dynamo the plant consists of a 750 light Fort Wayne generator and 50 light Ball arc machine, skeleton switch-board and Canadian General instruments. Power is supplied by a 45 h. p. Wheelock engine. This company have about 400 incandescent lights and 10 arc street lamps. The arc system was first installed in 1891, and the incandescent system added two years ago.

The Hamilton & Dundas Railway Co. have ordered a 200 k.w. 500-volt railway generator from the Canadian General Electric Company.

ELECTRICAL MACHINERY AT THE MERRITON CARBIDE WORKS.

THE Willson Carbide Works Company, at Merriton, Ontario, is probably the only enterprise engaged in the manufacture of carbide of calcium, which is turning out that much discussed product, daily, up to its full capacity, and at a profit. The electrical apparatus used in this plant is of the most interesting character, having been specially designed by the General Electric Company to suit the peculiar conditions under which the manufacture of carbide can be successfully carried on.

The company have at present in operation four machines of 150 kilowatts capacity each, and have recently placed an order for two more of the same size, which will be in operation in the course of a couple of months. These generators are of the revolving field type, with stationary armatures, and are designed to run continuously twenty-four hours a day, at a load considerably in excess of the rated output, without a noticeable rise in temperature. The characteristics of these machines are such as to enable them to supply a proper amount of current for a furnace at the proper voltage,



150 K.W. C.G.E. GENERATOR FOR THE MERRITON CARBIDE WORKS.

no matter what the resistance conditions of the arc may be, and they may be short circuited repeatedly or even run on a short circuit without injury. The location of two of the power houses renders necessary a transmission at 1000 volts, and in this case step-down transformers of the Niagara type are used to reduce the current to the proper voltage for supplying the furnaces.

Altogether the detail and operation of this plant is most interesting, and its success in turning out carbide of calcium on a commercial basis is in marked contrast to the operation of several plants, on a much more ambitious scale, which have been established in the United States.

DIRECT-CONNECTED ARC UNITS FOR THE LACHINE COMPANY.

THE Lachine Rapids Hydraulic & Land Company have ordered from the Canadian General Electric Company two direct-connected units for furnishing arc lighting from the citizen's station, from which they are at present supplying some 400 arc lamps, generated from steam power, with small arc machines of the "Wood" and "T-H" type. These new units will consist of synchronous motors of the three phase, revolving field and stationary armature type, each of which will be

direct connected to two 125 light "Brush" arc machines. The motors will be wound to take current at 4,000 volts, direct from the primary circuit of the Lachine company, thus saving the cost and loss in operation entailed by the use of step-down transformers. The motors will be self-starting, and are designed to operate at a very low temperature up to the rated load. The efficiency of the arc plant, operated in this way, should be very high, that of the 125 light Brush arc machine being not less than 86% to 88% at full load.

QUESTIONS AND ANSWERS.

"BACKWOODS" writes: Sir,—As there are many in the backwoods like I am, I think it would not harm us if some of our societies would send you a list of the questions brought up for explanation at their meetings, and the answers given. Kindly insert this, and oblige.

"ECONOMY" writes as follows: Please say if using a dimmer decreases the amount of current used when decreasing the light. Does the dimmer not use up the decreased light? Would a lighting company allow me to put in a dimmer between the meter and transformer?

SIR,—In answer to James McPherson: I have had the same trouble myself, and don't know yet what is the cause. I found that graphite and a little cylinder oil cured it almost entirely. I did away with the sight feed lubricator, and made two cups out of pipe fittings and globe valves, and they work fine. If a good cup sight feed for graphite could be got, it would be so much better, and I would like to know of one.

"GEORGE."

"ONTARIO" writes, in reply to Mr. Wickens, that the pumps are for ordinary water pumping; one is 200 feet from boiler and has a pressure regulator to govern its working. The drying room is common live steam coils. Referring to Mr. Thomson's reply he says: My engine, a $9\frac{1}{2} \times 12$ ", drives one 200 ampere 125 volt dynamo, and has a load of about 50 amperes for seven hours a day. Would I gain by lowering the pressure during that period to 50 lbs.; at present we carry 80 lbs.

"SUBSCRIBER" would like to ask Mr. Thomson how it is that in the "Green Economizer" tests they can have a sufficiently good natural draft, with a temperature of 200° after it has left the economizer. Would the pipes last long, or would they be giving out all the time if put inside? Is there any real economy in using live steam to heat feed water for the boilers?

"J. G." writes, in reply to Mr. Wickens: My building is already piped, and we can make no alteration in piping. We have a steam drum in boiler room, from which nine mains rise and go up to the different floors; also a return drum, where all the water comes back into, and then into a trap.

The author of a paper presented to an English society says that in the only case of a split steam pipe within his recollection the accident was caused by the boiler water having been allowed to prime into it, producing, probably, sudden contraction. It is difficult to see how water of the same temperature as the pipe could produce contraction. Water hammer would be a better explanation.

DYNAMO TROUBLES AND HOW TO OVERCOME THEM.*

By PERCY DOMVILLE.

WITH modern uses of electricity the increase in the demand for light and power has, in many cases, proven too much for modern power stations to meet. These plants, installed ten or fifteen years ago, when the general application of electricity to purposes of illumination first became evident, have now become obsolete, or so far behind the times as to be unable to furnish a satisfactory service. These same installations under ordinary circumstances, to the uninitiated, apparently give perfectly satisfactory results, and the question is often asked by directors of companies: "Why purchase new machinery when we are filling the bill with the old? have had a few mishaps, it is true, and the power has been shut off for short times now and then, but what does it matter if we do stop for a few minutes, or even hours, if we give all that is necessary during the rest of the time." Now, the consumer of the present day, when he pays for a thing, expects to get it. So it is with the man who is depending on the electric company to light his house or to furnish power to run his shops, as the case may be. It is in nine cases out of ten that the power is shut off at a critical moment; hence it is that these companies with obsolete machinery fail to keep their consumers, many of whom feel compelled to install the more isolated plant.

With the introduction of so many of these plants, it becomes necessary for the stationary engineer of the present day who is called upon to take charge of dynamos and motors in connection with his engineering duties, not only to be thoroughly posted as to the care and running of his engine and boilers, but to be somewhat of an electrician as well. Many times he is compelled, when he takes a position, to run chances of the machinery not getting out of order, and how often is he censured for the apparatus getting out of order when the injunction has been laid against him not to meddle with any portion of the machine or its adjustments. No engineer can take charge of an engine and boiler until he has passed a thorough examination as to his fitness. Still, machinery far more delicate and liable to get out of order is forced upon him. A mischievous person with a little smattering of electricity can give him no end of trouble when, if the engineer thoroughly understands the machinery, he could easily locate or determine the same.

It is not essential that he should cram his head full of the theory of that "mysterious force," but he should endeavor to post himself thoroughly as to the care and running of any electrical apparatus which may be placed under his charge. The modern dynamo is, as a rule, a well built machine, and if proper care be taken should require very little attention; but accidents will happen, and many dollars have been lost through the engineer not knowing what to do in case of an emergency. I therefore will endeavor to give you a few hints as to the care of a dynamo and an idea of some accidents which are likely to occur, and the best way to look for and repair the same.

POSITION OF THE DYNAMO.

To begin with the position of the dynamo cannot be too well looked after. More often than not, little consequence is attached to this important point, the dynamo being pushed into some dark, out-of-the-way corner, where not only is it next to impossible to see, should anything go wrong, but where it cannot be kept clean. It is most desirable that the position chosen should be in a cool, dry place, free from dust, where the machine can be readily seen and of easy accessibility. This condition is not difficult to fulfil, and the engineer will benefit by it in the end. Plenty of room on all sides should be allowed, as it is not the most pleasant thing in the world to handle in cramped corners a dynamo which may be running at a high rate of speed and voltage.

In choosing a place for a dynamo the switchboard must not be forgotten. It is true that there may be but one switch and fuse block, but it is important to have them where they can both be seen and reached without loss of time. If possible, place the switchboard and dynamo where they and the engine can be readily seen from one point, and where, in case of emergency, they may be reached with the least possible delay. For instance, if a fuse blows out it should be in a position where it would be quickly noticed. The chief object in selecting a place for the dynamo which is free from dust is that dirt is one of the electrician's greatest enemies, and it can be safely said that over fifty of the so-called diseases of dynamos may be traced to this cause. A dynamo, in fact, any kind of electrical apparatus, can-

not be kept too clean. In cleaning, merely a general wiping is not sufficient, but thorough inspection of every part, for it is the dirt in the out-of-the-way corners which gives the trouble.

THE COMMUTATOR.

In cleaning and inspecting a dynamo, perhaps the most important part to be attended to is the commutator. This, if it has been properly looked after, should have a dark polished surface, and every effort should be made to keep it in this condition. This can only be acquired by cleanliness and proper adjustment and care of the brushes. FIRST: See that no dirt has lodged between the segments or between the lead wires where they join the commutator bars. (A stiff dry brush is useful for this purpose). This is important, as many an armature coil has been burned out owing to short-circuiting at the commutator, caused by dirt or copper dust accumulating at the points mentioned. SECONDLY: The commutator may be running sparkless, and no fear of trouble suggest itself to the engineer. When the machine is stopped, however, careful inspection may show signs of burning along the bars. This should be remedied at once, for if allowed to remain the result will be badly sparking brushes and development of flats in the commutator. A fine file should be used to smooth the burnt parts, or if too far gone the commutator should be slightly burned down. This latter practice is nearly always necessary in the use of flats. It is difficult to explain just how these flats occur; there are three or four causes possible: (1) One of the bars may be of softer copper than the rest, and so wear away faster, but this is not likely; (2) a partial disconnection in the armature at the part connected to the particular flat bar, will cause a spark at every half revolution, so biting away the bar. The trouble in this case will, in all probability, be found where the lead wires join the commutator; (3) another cause of flats is a badly balanced armature, which, vibrating badly when running, will cause the brushes to jump and spark, burning away one or more of the segments. If the commutator is a new one, particular attention should be paid to keeping the segments firmly held in position. This can be done by tightening the nut or nuts at the end of the commutator. The commutator should frequently be smoothed with fine sandpaper and oiled until a finely polished surface is obtained.

As before mentioned the proper adjustment of the brushes plays an important part in the care of the commutator. There is no part of the dynamo that will give the novice more trouble than the brushes, and here again let me impress upon you the importance of cleanliness. A clean, well trimmed brush, properly adjusted in its holder, screwed down to bear against the commutator with just sufficient force to prevent jumping and consequent sparking and yet not so hard as to cause excessive wear, should give little trouble, provided the commutator is in good condition. See then that each brush is properly trimmed; that is, cut square across, and if copper, filed off at the proper bevel. If carbon the brushes should first be placed in the brush holders and a coarse piece of sandpaper inserted between them and the commutator. Then by rocking the rocker-arm the brushes are worn away to the shape of the commutator.

There is no general rule for the thicknesses of brushes, but one and one-half the thickness of the commutator bar is near the mark. The object is to have the brush wide enough to short circuit each section of winding for a certain brief time, in order that the current may be reversed; the power of the entire machine being dependent, of course, upon the principle of a rapidly opened and closed circuit creating an induced current. It is much easier to go astray in the thicknesses of brushes when copper is used, as the angle at which they are set is apt to vary. A very good practice is to make a cross section of the commutator, and brush holder full size. Then by drawing in the brush the proper angle can be found, and a piece of wood the shape of the brush can be cut for a template. In adjusting the brushes in the holders, take care that all the leaves, if copper, are in contact the whole width of the brush; if not the result will be a spark, and the longer the machine is allowed to run in this condition the worse it will get. This can be prevented by marking the length on your template and making a gauge to set your brushes to. The same care should be taken to see that the brushes bear on precisely opposite bars of the commutator, or if a four pole dynamo, that they bear on bars that are a quarter of a circumference apart. A very good way is to mark the commutator bars with a centre punch, so that this adjustment may be verified. Having properly cleaned, trimmed and adjusted the brushes, seeing, of course, that they are all firmly screwed to the holders, they should be raised from

* Paper read before the Hamilton Association C. A. S. E., by Mr. Percy Domville, of the Westinghouse Company.

the commutator by the hold-off catches, and left in this position ready for running.

Outside of the commutator and brushes a general cleaning up is necessary. Remove all traces of dirt from the frame, look carefully over all insulators of brush holders, binding posts, switches, field coil, ends, etc., also between the armature and pole pieces, inside the pulley and around the foundation. Turn the armature round by hand to see that nothing catches, and no loose wires or waste are adhering to it, and that the binding wires are loose. See that the oil cups are full and drip properly. If self-oiling, see that the oil wells are full. Then, seeing that all terminals are screwed down tight, the dynamo is ready to run.

STARTING THE DYNAMO.

Just a word about starting the dynamo. First, run your machine with the brushes raised and main switch open to see that all is right mechanically. Before closing the main switch make sure that the voltage is correct and brushes do not spark. To correct the latter fault rock the brushes forward or backward till a sparkless place is found, then close the main switch. I might here mention that it is also important to see that all dirt is removed from the switchboard and connections. Examine and clean occasionally the field rheostat contact and contact shoe.

MISHAPS AND BREAKDOWNS.

It would take too much time to go into all details of the mishaps and breakdowns which are likely to happen in the running of a dynamo, but I will mention a few most likely to occur.

BURNING OUT OF ARMATURES.—It is almost impossible to give any definite rules for the prevention of the burning out of armatures, owing to the probable cause of the trouble being difficult to foresee. Still there are a few points which should be remembered in this connection. As before mentioned, short-circuiting at the commutator is one cause. Burning of insulation under the binding wires will short-circuit the conductors. Short-circuiting in the armature itself is another cause which cannot be foreseen. All that can be done is to let the coil burn out and repair it afterwards. In drum armatures, and in those forms of ring armatures, which are so connected that the windings cross one another, this evil may occur in consequence of the abrasion of the insulation. Short-circuiting between an imperfectly insulated wire and the iron core beneath it is again a fruitful source of trouble.

FIELD MAGNETS.—As a rule, field magnet coils give little trouble, but when they do the difficulty is hard to locate owing to their compactness. Disconnections and short circuits are most common. When there is a disconnection the machine will probably refuse to excite itself. To make sure, the coils should be disconnected at the ends and tested. A common electric bell will tell you if the wire is continuous. If the wire is broken below the surface, the only way to get at it is to unwind it. A short-circuit between any two of the windings will have the effect of keeping the short-circuiting part cool whilst the rest is hot. The coil may be short-circuited on the frame, which can be tested with the bell.

SPARKING BRUSHES.—Any of the following will cause sparking brushes; copper or carbon dust between sections of commutator; copper or carbon dust or oily matter on brush holders causing leak to frame; open circuit in armature, overload, brushes not at neutral point; brushes covering too many segments; brushes not making good contact or loose in brush holder; flats in commutator; too weak a field wire of armature touching pole pieces.

A dynamo that has been giving little trouble suddenly ceases to generate. On examination everything is apparently in good order, and yet it is impossible to get a spark from it. First, look for an open circuit. This may be done with the electric bell, although it is not always a sure test, as a ring may be obtained when a wire is broken and held together only by insulation. Here dirt may play an important part. Look closely for it under the coupling screws, binding posts, and between the brush holder and brush holder rod. A very small particle may be responsible as the following will show: An arc lighting dynamo ceased to generate, in the manner mentioned. By short-circuiting the brushes it was found possible to obtain a flash, while outside of the brushes this was impossible. It was plain, then, where the trouble lay. The brush holder had already been examined, but on again looking, one of the insulators was found to be charred close to the rod for about an eighth of an inch. This was caused by dirt lodging between the insulators and brush holder. It was little, but enough to grind the brush holder on the frame. Other causes for machines failing to generate are explained as follows: A dynamo standing idle for some time may fail to light when

wanted, through a wire in the field circuit being broken and held together only by insulation; or after the connections have been taken apart for the purpose of cleaning, and put together again, trouble has been caused through crossing connections to the field. An expert leaves an engineer in charge of an arc machine, and is called back without loss of time, as the machine will not work, and he finds the switch open in the field circuit. When closed the trouble ceases. In this case the trouble is caused by a matter so trifling as to escape the mind of the instructor.

During a thunder storm a flash was noticed at a dynamo following a vivid flash of lightning, and immediately all lights went out. The dynamo field refused to generate, giving the engineer in charge the mistaken idea that it was burned out. On investigation it was found that the flash had been caused by one of the binding posts short-circuiting on the frame, the result of lightning striking the line.

An engineer, after cleaning the brushes of a dynamo, could not obtain a spark from it. He had forgotten to screw the lower brushes against the commutator. Another, after hunting for a long time, took the cover off the fuse block and found the fuse blown. These experiences, likely to be met with at any time with any dynamo, are worth remembering.

These are a few of those difficulties which will come to every one in the responsible position of electrical engineer. There are many points about every machine which should be carefully watched, and faults to be remedied before they become serious. There is much that can be gained by experience, but a conscientious worker, giving all his mind to his duties, will find himself the gainer, for each day's experience will teach some new point, and what is learned in this way is not soon forgotten.

SPARKS.

The Kingston electric street railway will be extended to Kingston Junction at once.

The Hamilton & Dundas Street Railway have purchased a four motor G. E. 1,000 equipment from the Canadian General Electric Company.

Robert Patterson, who resigned his position as engineer at the Hamilton General Hospital to go to the Klondyke, was drowned in the Athabasca.

Mr. Jacob Morley, of New Hamburg, Ont., has placed his order with the Canadian General Electric Co. for a new 300 incandescent light dynamo, to be run in connection with his present system.

Warton is to have incandescent light. Messrs. Young & Crawford have closed a contract with the Canadian General Electric Company for a 35 kilowatt single phase alternator. Work on the installation of the plant is proceeding rapidly, and light will be turned on in about two weeks.

The Teeswater Electric Light Co., which has taken over the operation of the waterworks and electric light systems at Teeswater, has decided to install an incandescent electric lighting system, and for this purpose have placed an order with the Royal Electric Company for one of their 500-light S.K.C. generators with transformers, etc., the work of installation to begin at once.

The Willson Carbide Works Company, of Merriton, Ontario, have recently ordered two additional 150 kilowatt revolving field single phase alternators from the Canadian General Electric Company. These machines will be installed in their No. 3 power house, and with the four already in operation, of the same type, will give a total capacity of 900 kilowatts to be used in the manufacture of carbide of calcium.

The Imperial Electric Light Company supply electric light and power to customers in the eastern part of Montreal. An agreement was announced last month by which the Lachine Rapids Hydraulic and Land Company will supply the Imperial Company with the power necessary to supply this service. The power will be brought from Lachine to the Imperial Co.'s station on Rachel street for distribution.

The Light, Heat & Power Company, of Lindsay, have added to their incandescent plant a 120 kilowatt standard single phase alternator of the Canadian General Electric Company's latest type, with revolving iron-clad armature and compounded to secure automatic regulation. The Lindsay Company have already a 60 kilowatt and 30 kilowatt machine of the same type in operation for several years past, and with their new apparatus will have ample capacity to supply the incandescent lights, numbering between six and seven thousand, connected to their circuits.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

NOTE.—Secretaries of Associations are requested to forward matter for publication in this Department not later than the 28th of each month.

TORONTO NO. 1.

Toronto Association No. 1 desire to call the attention of engineers to the fact that they intend holding open meetings on the third Wednesday evening of each month. At the meeting in November a lecture will be given by Mr. J. J. Main, the well known boiler maker, on the construction of boilers, which promises to be very interesting. All engineers and manufacturers are invited to attend.

HAMILTON NO. 2.

Hamilton association are holding open meetings of instruction twice a month during the fall and winter. The association is quite prosperous. At the meeting on October 12th an interesting paper on "Dynamo Troubles, and How to Overcome Them," was read by Mr. Percy Domville, of the Westinghouse Company, which will be found on another page. A paper by Mr. E. J. Phillip, Toronto, is also printed elsewhere.

KINGSTON NO. 10.

The meetings of the above association are very instructive and profitable, and much interest is taken in the question box. It is the intention to prepare a set of models of boilers for the purpose of instructing the members in boiler construction, and to show how they should be stayed to strengthen them.

EVAPORATIVE CONDENSER OR COOLING TOWER.

At an open meeting of Hamilton Association C. A. S. E., Mr. E. J. Philip, chief engineer for the T. Eaton Company, Toronto, read by request the paper on "Condensers" presented at the recent annual meeting of the association at Brockville, supplemented by the following:

EVAPORATIVE CONDENSER OR COOLING TOWER.

The evaporative condenser or cooling tower is made to operate where the supply of water is limited, or where it has to be bought. This apparatus is in every way the same as an ordinary condensing plant, except that in addition to the air pump and condenser there is a tower for cooling the water after it has been heated by condensing the steam; its construction will be taken up later on. This apparatus is the outgrowth of the increasing number of steam power plants in recent years with vastly increased capacities, which has of necessity raised the price of the lower grades of coal. Whenever fuel goes up in price, or where the quantity is increasing, due to increased load, the steam user begins to look around for some means of reducing the rising fuel account. During the last few years engineers have had every opportunity to put in what may be called ideal plants, and others have had the opportunity to improve the plants under their control. How far many have succeeded is known only to themselves; if any part is a success it becomes known and is copied or improved on. The principal improvements during the last few years have been due to higher steam pressures, increased number of cylinders, and where water was at all available, running non-condensing; and the absence of water in sufficient quantity to use for condensing purposes at a point where it is desirable to locate a power plant has caused it to be located at some remote or less desirable point. The necessity of having water for condensing purposes being so necessary, it left no alternative.

The cost of running condensing and using water from a city main is out of the question, as it costs more for water than is gained by condensing. This being the case, it formerly left no alternative but to run non-condensing or build the plant where there was an abundant supply of water without regard to the disadvantage of the location. This has been overcome by improvements in an apparatus that has been used for years in a crude form for other purposes. The first purpose it was used for

was for cooling water that had been used for cooling beer. This form of tower was simply a square frame work, filled with brush or limbs of trees; the water was pumped to the top through a sprinkler, and in falling over the loose brush, it spread out in thin sheets over the surface of the wood and was acted on by the air, the warm water causing a current of air to circulate through the filling. The present tower is simply an improvement on the first idea, and when used in connection with a steam engine it takes the place of a natural source of water supply.

With this apparatus a plant can be made to run condensing, with less water than it can run non-condensing. The reason of this I will explain after a description of the tower, which will now be in order: The cooling tower is usually square or rectangular in form, but it is sometimes made round, and is filled with partitions. The partitions may be made of any material. The Worthing tower is filled with tile. The Barnard tower is filled with wire netting, the Gradier with wood, and sheet iron has been used by different parties. Any material that will give a large surface will do, the object of the partitions being to spread the water out in thin sheets over the surface. The partitions do not extend to the bottom of the tower, but a space is left below them into which a fan discharges air. At the top of the tower a distributor is attached to distribute the water over the partitions. Now, the action is this: Imagine an engine condenser and taking its injection water from the bottom of the tower, (into which a quantity is put when the tower is first started). Now, when this water has condensed the steam, and passes on to the air pump, instead of to the pump discharging the water to the sewer, it discharges it to the top of the tower into the distributor, where it is evenly distributed over the filling. It spreads out in a thin film or sheet, and passes slowly down the partitions. The fan is running and its air is passing up between the partitions and acts on the water in three ways, thereby cooling it by the time it reaches the bottom of the tower sufficient to again condense more steam.

The way in which the water is cooled is: First, the water loses some of its heat by radiation from the piping between the tower and condenser, also from the sides of the towers. Next, the air is raised in temperature carrying off heat in this manner, and the last, and by far the greatest cooling effect, is obtained by the air evaporating a certain quantity of the water, carrying off heat in the vapor as latent heat.

I made the statement that with this apparatus a plant could be run condensing, with less water than it can be run non-condensing, and I will try and prove this. Take an engine running non-condensing, and using say 25 pounds of steam per h. p. hour, and taking its water from the city main; if it is say 100 h. p. it will use 2500 pounds per hour. Now, this water is being exhausted out into the air in the form of steam. If we attach a condenser and cooling tower to the engine, and it saves at the engine, say 20%, the engine will use 20% less water, which will make the water consumption 20 pounds per h. p. per hour, or 2000 pounds per hour for the 100 h. p. When condensing, instead of the water passing off as exhaust steam, it is pumped into the cooling tower, and for every pound of water evaporated by the air sufficient heat is carried off to cause a cooling effect sufficient to condense one pound of steam. If all the cooling effect that took place was due to evaporation, there would be water, neither gained nor lost, as there would be as much evaporated as condensed, but as I said before, a certain cooling effect by radiation takes place, and the water cooled in this way can do the work of condensing and is not evaporated. Then the rise in temperature of the air carries off considerable heat without evaporating any water, so that between these two sufficient water is saved to cause a slight overflow from the tower all the time, and as the boilers are using 20% less water, it follows that in this way you are running condensing with 20% less water than you can run non-condensing.

The tower that was built this summer where I am employed is a rectangular structure, 19 feet high, with a vapor stack on the top 9 feet in diameter and 26 feet high, the body of the tower being 10 x 12. It has an 18 inch water space at the bottom and two five foot fans. The filling is 12 feet long. The distributor is made of pipe, and works very nicely. The tower runs in conjunction with a 500 h. p. surface condenser with combined air and circulating pumps, built by the Northey Co., of Toronto. The condenser has 800 brass tubes 8 feet long, making over a mile of tubing, with 1600 stuffing boxes. The water leaving the condenser has a temperature of 120° to 128°; it cools in the tower down to 68° to 80°, according to conditions. It has been cooled down to 10° below the outside atmosphere, and by supplying plenty of air this could be done at anytime.

SPARKS.

The village of Sutton, Ont., will be lighted by electricity.

A new dynamo will be placed in the Russell House, Ottawa.

Leonard Ervin, electrician, Halifax, N. S., is announced to have assigned.

The electric plant at Magog, Que., will be completed before the end of the present month.

We understand that the Eastern Mining Syndicate, of Rossland, B. C., will install a complete electric plant.

The ratepayers of Cote St. Paul, Que., have decided to have electric light. A plant will be put in next summer.

Mr. R. B. Angus has succeeded Mr. G. C. Cunningham as a director of the Montreal Street Railway Company.

Mr. A. H. Deike, of Guelph, Ont., has invented an acetylene gas generator, for which he claims many advantages.

Mr. J. A. Cokers, manager of the Bell Telephone Company at St. Johns, Que., has put in a new long-distance telephone.

The Bridgewater Electric Light Co., Limited, Bridgewater, N. S., has been succeeded by the Bridgewater Power Company.

The Woodstock, N. B., Electric Light Co. is said to have been fined \$50 for failing to register under the electric light inspection act.

W. H. Green, of Wingham, has been given the contract for electric lighting for Listowel, Ont., and will erect the power house and put in the plant at once.

An English syndicate, with large capital, is said to be negotiating for the purchase of the franchises of Canadian lighting companies, both gas and electric.

The Bushnell Oil Company have just completed extensive works at Sarnia, Ont. The works cover over 13 acres of ground, and cost upwards of \$175,000.

The Canadian General Electric Company are installing a 200 light direct current incandescent plant for the North American Bent Chair Company, Owen Sound, Ont.

William Peterson & Company, Limited, of Brantford, have put in a 200 16 c.p. light dynamo. It is a 100-volt machine, manufactured by the Stevens Mfg. Co., of London.

The Lake of the Woods Milling Company at Keewatin have ordered a 25 kilowatt, steel frame, multipolar, direct current generator from the Canadian General Electric Company.

The Dominion Electric Heating & Supply Company, of Ottawa, have made a proposition to supply light and power to the village of Papineauville, Que. An exclusive franchise for 35 years is asked for.

The earnings of the Toronto Street Railway Company for the months of July, August and September show an increase of \$35,323 over those for the same period last year, due to Sunday cars and conventions.

Prof. James J. Guest, recently assistant professor of mechanical engineering at McGill University, Montreal, has been appointed professor of mechanical engineering in the Polytechnic Institute at Worcester, Mass.

The formal opening of the street railway at Sherbrooke, Que., took place on November 1st. The service of the road will be about twenty minutes in the city and forty minutes to Lennoxville, a total length of five miles.

The German post-office is experimenting with an invention, an electric typewriter apparatus, which, at a cost of \$125, can be connected with a telegraph wire, and messages which are typed off on the keyboard at one end reproduced at the other end.

The bankrupt stock of C. W. Henderson, Montreal, has been purchased by Geo. Clime. The electrical supplies, amounting to \$2,639, sold for 44 cents on the dollar; manufactured goods, amounting to \$1,081, 32 cents; and the machinery, value \$801, at 76 cents.

Mr. W. C. McDougall, a well-known mining man, is reported to have organized an English company to build smelters at Grand Forks, B.C., in connection with which electric tramways will be employed for carrying the ore. The company is capitalized at \$2,000,000.

The Chatham Gas Co., of Chatham, Ont., who have been operating an arc and incandescent plant in that town for the last ten years, have decided, owing to the corporation installing a plant and doing the street lighting, to go more extensively into incan-

descent lighting, and for this purpose have purchased a 2,000-light alternating dynamo from the Royal Electric Co., which is to be installed at once.

The City Council of St. Thomas, Ont., has decided to submit a by-law to the ratepayers on Tuesday, November 30th, to guarantee the bonds of the street railway to the amount of \$50,000 and pay the first year's interest, in consideration of the horse car railway being electrified.

The village of Iroquois, Ont., defeated a by-law last month to borrow \$8,500 to purchase an electric light plant, the majority being twelve votes. There is said to be a good opening there for a private company to put in a plant, as the corporation have a wheel pit, intake pipe and tail race.

It is rumored that Mr. H. B. Spencer will resume his former position as assistant superintendent of the eastern division of the C.P.R. Mr. Spencer's position as manager of the Hull Electric Railway is being temporarily filled by Mr. John Brown, the superintending electrician.

The Minister of Public Works proposes to ask parliament for a large vote for extending the government telegraph lines in the Northwest and British Columbia, where already the Dominion government owns 700 miles of telegraph lines. The department is at present considering whether it will be better to extend the present line from Quesnelle, B. C., to Dawson, which will be a long way through a wild and unknown country, or simply to build a short line, about 70 miles in length, across the Chilcoot pass, connecting Dyea with Teslin lake.

The annual meeting of the Standard Light & Power Company was held in Montreal last month. The agreement made by the directors for the purchase of the 1,000 horse power from the Lachine Rapids Company was ratified, the power to be distributed by the Standard Company in the centre of the city. The following board of directors was elected: Messrs. J. H. Burland, Peter Lyall, W. S. Evans, W. McLea Walbank, L. H. Henault, Ste. Cunegonde; F. Dagenais, St. Henri, and M. P. Davis, Ottawa. At a subsequent meeting of the board the following officers were elected: Mr. W. McLea Walbank, president; Mr. J. M. Burland, vice-president; Mr. E. Craig, secretary.

Mr. Adam Rutherford, formerly secretary-treasurer of the Hamilton, Grimsby and Beamsville Electric Railway Company, recently entered action against the company claiming \$5,000 damages for alleged wrongful dismissal from the position of secretary-treasurer, and \$833 salary in arrears. Mr. Rutherford was the promoter of the company, and was awarded \$2,000 stock in payment of his services, and subsequently engaged as secretary-treasurer at a salary of \$800 a year, to date from March 1st, 1894. The defence alleged that the grant of stock covered payment for his services until a year later. After a conference between the parties a settlement was arrived at under which Mr. Rutherford received \$233 and each side paid its own costs.

The Electrical Engineer states that figures recently compiled from nearly 1,100 plants, with 300,000 lights, scattered over 46 states, and including stations of all sizes under all conditions, show the general average contract price for arc lights, burning 3,326 hours a year, with coal costing \$3.03 per ton, to be \$101.18. In Pennsylvania, where coal costs \$1.56 per ton, the average price is \$85.75, while in Ohio, with coal at the same price, the average cost is \$78.87. But in Pennsylvania the average burning is 3,931 hours per year, whereas in Ohio it is only 3,350 hours. In California, with coal \$7 per ton, the average price per light is \$119.68, while in Colorado, with coal at only \$3.18, the lamp price reaches \$129.31. It will thus be seen that the average price of arc lighting depends largely upon local conditions, cost of labor, fuel, etc.

The term 'horse power' when applied to a boiler is always misleading, says Power, besides being a misnomer to start with. A hundred horse power boiler will supply steam for a modern engine to develop 200 horse power. The term should be avoided when speaking of boilers whenever it can be gracefully done, and we notice with gratification that an English writer says of water-tube boilers that 'the approximate cost erected is £96 per 1,000 pounds evaporation.' That is to say, you can buy and erect for £96 enough boiler to evaporate 1,000 pounds of steam per hour. You can use the steam in a pump at an expense of 200 pounds per hour per horse power, making the boiler supply five horse power, or in a compound engine at an expense of 13 or 14 pounds, making the boiler supply 70 horse power, or you can it for boiling glue and generate no horse power at all.

ELECTRIC RAILWAY DEPARTMENT.

ELECTRIC POWER FOR TRUNK-LINE RAILWAYS.

THE subject of the application of electric power on trunk-line railways, and the extent to which this power is likely to be employed in the near future for trunk lines of considerable length, is just now attracting much attention from electrical engineers, manufacturers and capitalists. In the Engineering Magazine for October the subject is very ably dealt with by Mr. George Forbes, the designer of the Niagara power plant. After pointing out that in many cases the circumstances differ, and that the amount of suburban traffic, facility of obtaining water power for generating electricity, and other special features must all be considered in weighing the advantages of the electric over the steam road, he makes the following reference to the Niagara Falls Park and River Railway, as being constructed and operated on the same principles as a steam railway :

"This railway is 12 miles long, of double track, resembling in every way the standard adopted by the Canadian Pacific Railway. The maximum speed attained is 30 miles an hour. Trolley wires are used. There are two motor houses ; one at the falls, worked by water power, the other a small auxiliary station at the Queenstown end of the road, with steam plant. There is 15 minutes' headway between cars, the average speed, including stoppages, being 13 miles an hour. Locomotives, in the ordinary sense of the term, are not used, but twenty-two motor cars supply this service, and are followed by trailers, etc. Some of the cars, when fully loaded with passengers, weigh more than twenty tons. There are eight regular stopping-places along the line, furnished with platforms. This railway has been referred to, not because of any special merit which it possesses, but because it is not a street railway, and because it shows a method of working. In fact, reference is made to it partly to draw attention to the extremely objectionable feature of it. When water power was available, it was not good policy to use steam power at a distance of 12 miles. Of course, if the electric pressure were only 500 or 600 volts, there would be a great waste of energy or an enormous expenditure of copper in carrying the current to even that short distance ; but there would have been no difficulty in transmitting electrical power at high pressure, transforming it down, and converting it into a continuous current. This would have saved nearly the whole expense of working the steam plant. It is important to give attention to this matter of the use of water power on trunk railways. There has been an absurd hesitation to undertake the transmission of power to great distances. If engineers who have had experience in the transmission of power and in the conversion of alternating into continuous currents would look into this question, they would be convinced that where water power is available it is generally economical to transmit electrical power hundreds of miles for working railways. As an example, it can be proved that, if the railway companies of Scotland were to combine to work their trunk lines by means of electric locomotives, the electric current being developed by the water power which exists in that country, then the whole of that service might be carried on without the use of steam locomotives.

Another lesson to be drawn from a careful consideration of the subject is that the waste of coal on steam locomotives is not by any means compensated by the extra cost and loss of power in electrical transmission. Estimates have been prepared which show that not only is the cost of copper prohibitive, but that the efficiency of the electric system renders the consumption of coal with stationary engines about as great as with locomotives. This is certainly not the case. The cost of electric transmission, when properly effected, is not comparable with what it is as calculated on the lines adopted in the past ; and, on the other hand, the efficiency of dynamos and motors has not been sufficiently considered in street railway practice in the United States. A very large part of the success of the Liverpool Overhead Railway is due to the high efficiency of the electrical machinery."

Reference is then made to the Baltimore tunnel, operated by electricity, the Liverpool overhead railway, and the City and South London electric railway, each of which possesses distinguishing features, and in the operation of which electric traction has been successful in competition with steam.

The reason why trunk lines have not been worked by electricity is claimed to be because the cost of transmitting electric power has been considered too great. The author points out that in a great deal that has been written on the subject it has been assumed that the electric pressure upon the feeders is only some 600 or 700 volts, while it is an indisputable fact that the feeders may be supplied with current at 10,000 volts or more, which may be in the form of continuous current, but which is more manageable as an alternating current.

At different stations along the line it would be reduced in pressure by means of transformers, and converted into continuous current by means of a commutating machine. It is in this point that machinery for working the proposed system has been the least developed. The commutating machine now on the market, introduced first by Mr. Shuckert in Germany, and applied in various factories at the Niagara works, is usually called a rotary transformer. It does its work admirably, but it is expensive, cumbrous, and requires continual attention. This last fact renders it impossible to lay such machines along a trunk line at distances of a few miles. But I have prepared the designs for a transforming and commutating machine free from all the defects referred to, which can be manufactured at small cost. After wide experience and laborious study of the whole question, the opinion of the present writer is that, as a rule, electric locomotives, with the power developed by steam, would, if the work were carried out on proper lines, be cheaper than the steam railroad up to a distance of between 40 and 50 miles from the power station. If water power were available for generating the electricity, the distance at which steam power would begin to be the cheaper on a busy line is several hundred miles. These statements are the result of calculations with coal at a dollar and a half per ton. This economy arises from the well-known fact that in the best trial tests of locomotives five pounds of coal are required for the h.p. hour, and from the fact, equally well known, that so good a result is rarely attained, in nearly every case the consumption of coal being several times as much as that

indicated. These conclusions, however, do not give much encouragement for the substitution of electricity for steam, except in special cases. A time may come when special railroads will be built over long distances to be worked electrically, and in that case there are advantages of a totally different character which will favor electricity, depending upon the fact that the locomotive will be abolished and power applied to every axle of the train.

The conclusions arrived at by Mr. Forbes, from many years of study, are as follows :

(1) In cases where water power is always available within a few hundred miles of a trunk line of railway, it is probable that economy would be served by introducing electric traction.

(2) In the case of an independent system of railway to be constructed in a new country utterly unaffected by the traffic from steam railroads, power can be applied to every axle of the train; wherefore it will be economical in such a case, in construction and in operation, to use electric propulsion in preference to steam.

(3) For desert railways, where water cannot be obtained, electric traction is eminently suitable.

(4) In underground railways, such as the Baltimore tunnel and the London underground system, where economy is not so important as convenience and comfort, electricity must be employed; and, where such railways are to be constructed, economy makes electricity advisable.

(5) In cases of suburban traffic electricity would help to overcome the competition with street railways by supplying the public with separate and independent cars running at very frequent intervals on a well-maintained track.

CREATING TRAVEL ON ELECTRIC RAILWAYS.

A MANAGER of a successful street railway, referring to the working up of excursion business on trolley roads, says :

"On a steam road the company asks its patrons to spend dollars, while on a trolley system we ask them to spend nickels, so how much more will they be open to persuasion? A resort to which a steam road carries passengers costs at least a dollar to reach, and it is an excursion people think about before taking, and they do not take it very often. With a nearby resort, reached by a trolley line, a man will make up his mind on an instant, perhaps, on seeing an advertisement. He can reach there in an hour or less, and it only costs 5 cents, and with a few more nickels he can spend an enjoyable evening. There are thousands of people who have a quarter, or 50 cents to spend who will go to a nearby resort in the evening if they think they can have a good time, and many of them have families they will take with them. It is my business to tell them where to go and what to do when they get there. For that purpose I keep in touch with all the proprietors of the summer resorts around the city, and just as soon as a novelty is introduced I let the people know of it, either by means of placards on the cars or else I fix up some sort of an attractive circular, always striving to avoid the commonplace."—Street Railway Review.

The receipts of the Hull Electric Railway for this year have exceeded those of last year by \$31,000. The company contemplate building a fine boating and bathing house at Queen's Park, Aylmer, next spring.

SPARKS.

There is talk in Brantford of an electric road to Paris, a distance of seven miles.

Toronto capitalists are said to contemplate the construction of an electric railway between Woodstock and Ingersoll.

This year the Montreal Street Railway Company have placed 36 new cars on their lines. About 200 cars all told are now in use on the company's lines.

The street railway in Victoria, B. C., is being greatly improved. Government street is being double-tracked, and a large number of new motors brought into use.

The Sarnia Gas & Electric Company are installing a 60 kilowatt Canadian General Electric single phase standard alternator to meet the demands of their rapidly increasing incandescent lighting business.

The number of passengers carried by the Quebec electric railway is said to have reached 243,000 during September. The new stock of \$80,000 issued to raise the total stock to \$400,000 was at once taken by the former stockholders.

A movement is said to be on foot in Peterboro for the purchase from the Grand Trunk Railway Company of the lines of railway extending from that town to Lakefield and Chemong, with a view to their conversion to electric roads.

The electric street railway is a great benefit to Ottawa. The average number of men employed is 300 and the pay roll \$10,000 per month. When the company commenced business three years ago they had eight cars, now 100 are necessary to conduct the traffic of the road.

It is rumored that a movement is on foot to construct an electric railway from Oshawa to Toronto, equipped to carry passengers and farm produce to the city. The promoters aim to interest prominent men in the municipalities along the route in the enterprise and induce them to become stockholders.

Mr. H. A. Dauphin, manager of the Bell Telephone Company, at Quebec, recently received from Hamburg a submarine cable to replace the one between Quebec and Levis, which was destroyed last winter. The new cable rolled up formed a cylindrical mass four feet wide and eight feet in diameter, and weighed 18,000 pounds. It was 3,000 feet long, 2¼ inches in diameter and contained six wires.

A suit for \$100,000 damages was recently begun at Osgoode Hall, Toronto, by the Toronto and Richmond Hill Street Railway, against the township of York. The suit arises out of the failure of the township to permit the company to build its railway through the township to Richmond Hill. Four miles of track were laid, and ten or twelve miles remained to be completed. The people of the township voted for the issuing of \$60,000 in debentures, and afterwards the council failed to carry out their decision.

The Montreal Street Railway Company have declared a semi-annual dividend of four per cent., and in addition a bonus of one per cent. It is said that the forthcoming statement will show that the company has made during the past year a good sized decrease in operating expenses. The expense of operation in 1895 was 59.20, and in 1896 was cut down to 56.48. This year it is not expected to be within two per cent. of as much as last. The earnings, over and above all dividends, expense of operation, etc., last year amounted to \$102,106.79.

The Chateaugay & Northern Railway at Montreal are making preparations to handle an extensive freight business in connection with the Canadian Pacific Railway. They have ordered from the Canadian General Electric Company, four motor G.E. 1,000 equipment, with four motor controllers and commutating switches. This outfit, though of less capacity, is similar to the large locomotive recently supplied by the Canadian General Electric Company to the Hull Electric Company, which has handled as many as thirty-three cars on a shunt.

A company is said to have been organized at Hamilton under President Myles, of the Hamilton, Grimsby and Beamsville railway, with a capital of \$200,000, to extend the electric railway from Beamsville to St. Catharines, a distance of 12 miles. The line will follow down the Queenston stone road, and be commenced, if nothing prevents, in the spring. Much activity is also being shown among the promoters of the electric road between Hamilton and Guelph. Mayor Hewer, of Guelph, is in correspondence with the authorities at Hamilton. This road would have been built months ago, but for the opposition of the farmers of Waterdown and Mountsbury.

EDUCATIONAL DEPARTMENT

INTRODUCTORY

After mature deliberation the publisher of this journal has decided to devote a certain amount of space each month to what may be termed an Educational Department, wherein both mechanical and electrical formula and mathematical problems will be discussed, illustrated, and as far as possible rule and example given. At the request of the editor, I have with pleasure undertaken to contribute to this department regularly each month, and before discussing actual mathematical problems, wish to briefly introduce the subject at issue.

The primary object of this department is chiefly to increase the value of an already valuable paper, by placing in the hands of every engineer who has any knowledge of the rudimentary principles of mathematics, such matter as will enable him by a little study to master the most intricate mechanical and electrical formula. Many of our most valuable engineering works and publications from time to time contain formula that is in many cases but vaguely understood, and very often entirely misunderstood, thus rendering an otherwise valuable work practically valueless to the reader.

Just at what particular point our calculations should commence became a matter of serious thought, and past experience had to be carefully considered, bearing in mind the fact that there are many really good engineers whose early education has, through force of circumstances, been deficient, and many others who, through lack of opportunity, have not been able to review their early education for years. Knowing by observation and experience the great necessity of having a thorough elementary education before attempting to digest and calculate problems, and the almost utter impossibility of the student arriving at a satisfactory conclusion of his studies without a thorough knowledge of the principles of mathematics involved, I have decided to commence at a point and carry out the programme outlined in this journal—commencing at the foundation and advancing by easy stages until the principles underlying the most obtuse and difficult formula can be readily explained and easily understood. The advantages to be derived from an education of this kind, coupled with practical mechanical ability, is too well understood to require comment.

The programme which has been outlined for the succeeding nine months will embrace:

DECIMAL FRACTIONS—Definitions and explanation of principles of, and method of reduction to common fractions, and vice versa.

SQUARE AND CIRCULAR MEASURE—Definition and explanation and practical demonstrations of.

CUBICAL AND CYLINDRICAL MEASUREMENTS—Definitions and explanations of, with practical hints.

SQUARE AND CUBE ROOT—Definitions and explanations of.

SAFETY VALVE CALCULATIONS—(Spring and Lever Types)—Principles of, with practical demonstrations.

BOILER CONSTRUCTION—Stays, rivets, joints and seams, iron and steel plate—strength of, with formula and practical demonstrations.

It is not the intention to fill these columns with a mass of figures hastily compiled without reference to any particular object; on the contrary, every problem will be carefully thought out, and only such information given as will be of use to you, and an effort will be made, based on experience and a knowledge of the requirements, to make his series of tests complete in every particular.

WM. THOMPSON.

[ARTICLE VII.]

STRENGTH OF BOILERS.

A STANDARD boiler, constructed in accordance with the Canada Steamboat Act, is assumed to have a maximum working pressure of one hundred pounds to the square inch and be forty-two inches in diameter, and, if made of best refined iron plate, shall be at least one-quarter inch thick, made in the best manner.

If boiler is made of steel, a maximum working pressure of one hundred and twenty-five pounds to the square inch is allowable; diameter and thickness of plate as above.

The tensile strength of the material for iron is to be taken as 48,000 pounds per square inch of section with the grain, and 42,000 pounds per square inch across the grain, and for steel 60,000 pounds per square inch. And when boiler and all joints are constructed in best manner, four may be taken as a factor of safety.

From the foregoing standard it at once becomes apparent that the required thickness of plate varies directly with the diameter of the boiler, and the safe working pressure varies inversely with the diameter.

From this we might construct the following formula to obtain the safe working pressure of any boiler:

$$\frac{TS \times 2T}{D \times FS} = P$$

Where TS=tensile strength of material,

2T=twice thickness of plate in inches,

D=diameter of boiler in inches,

FS=factor of safety,

P=safe working pressure.

It becomes evident, however, that since plate must be somewhat weakened by having holes drilled or punched in it to receive the rivets by which the plates are fastened together, and that the rivets themselves must have a direct effect on the strength of the seam, it is necessary first to determine the strength of the punched plate at the joint as compared with the solid plate, and also the strength of the rivets as compared with the solid plate.

The well-known axiom that the strength of a chain is its weakest link is borne out here in a remarkable degree, and the weakest part of a boiler is certainly the strength of that boiler.

Consequently, before we can determine the safe working pressure of a boiler, its required diameter or required thickness of plate, we must first determine strength of all rivetted seams.

It is self-evident that the strength of any section of plate must be its width multiplied by its thickness, multiplied by the weight required to break it..

For example, let us assume we have a piece of boiler plate one inch in width and one-quarter inch thick, and that it broke when a weight equal to 48,000 pounds per square inch of section had been applied to it. We should require to exert a force equal to $1" \times .25" \times 48000 = 12000$, which is the greatest possible strength we may expect to get per sectional inch of this plate.

Suppose, now, we drill a hole in the centre of this plate, we clearly reduce its sectional area and consequently its strength. Obviously, then, both the pitch of the rivets and their diameter must be taken into consideration in computing strength of plate at seams as compared with the solid plate, and we might say that width of plate in inches minus diameter of rivets, multiplied by number, and difference multiplied by thickness of plate in inches, multiplied by

tensile strength of plate per square inch of section, will equal strength of plate at joint, or

$$p - (d \times n) \times T \times TS = s;$$

and since we want to know what percentage of strength punched plate bears to solid plate, we may modify this formula and get the formula required by Board of Trade Rule:

$$\frac{(p-d) \times 100}{p} = \text{percentage of strength of plate at joint as compared with the solid plate.}$$

We now have found the strength of plate when prepared for the rivets, and must now consider the strength of the rivets employed to fill up these holes, so that the operation of making the seam may be completed.

As already seen, the plate has been weakened by having had holes made in it. We now proceed to fill up these holes with rivets, and I need hardly point out that if the strength of the plate is greater than the strength of the rivets, and the boiler loaded to the strength of the plate, the rivets will give out by shearing across. We endeavor to get as strong a joint as possible, and for this purpose put in as many rivets as practicable in a seam. Suppose, however, we put the whole of the rivets in one row, we have reduced the plate area, and the stronger our rivet section becomes the weaker becomes the sectional area of the plate at the joint.

Therefore it is customary to divide the rivets into two, three or more rows, as by doing this the same strength of rivets is retained and the rivets are pitched a reasonable distance apart, enabling a fair percentage of strength to be obtained in the plate.

Then, if we knew the shearing strength of rivets per square inch of section, we may say that $d^2 \times .7854 \times Ss$ =shearing strength of rivet when only one row of rivets is used. Then $d^2 \times .7854 \times Ss \times N$ =shearing strength of rivet when two or more rows are employed.

Where d^2 =diameter squared,

.7854=constant,

Ss=shearing strength of rivets,

N=number of rows of rivets.

Then,

$$\frac{d^2 \times .7854 \times Ss \times N \times 100}{p \times T \times TS} = \text{percentage of strength of rivets as compared with solid plate.}$$

Since both shearing and tensile strength of plate may be considered as equal, we may cancel these and proceed to get strength of rivets by formula adopted by Board of Trade:

Where

$$\frac{a \times N \times 100}{P \times T} = \text{percentage of strength of rivets as compared with solid plate.}$$

Where a=area of rivets,

N=number of rows,

P=pitch in inches,

T=thickness of plate in inches.

From these two formulae, then, may be ascertained both the strength of plate and rivets as compared with solid plate, and it follows that the least of these percentages is the strength of the joint.

NOTE: When rivets are exposed to double shear, percentage of strength obtained from foregoing formula may be multiplied by 1.75.

Example (1): Find the strength of plate at the joint as compared

with solid plate if the rivets are 1/2 inch in diameter and pitched at 2 1/2 inches.

$$\frac{P-d}{P} \times 100 = \frac{2.5-.5}{2.5} \times 100 = 80\%$$

strength of plate at joint as compared with solid plate.

Example (2): Suppose that pitch and diameter of rivets in a double-rivettted joint are same as in example No. 1, and thickness of plate equals half an inch, what will be the strength of rivets as compared with solid plate?

$$\frac{a}{P} \times \frac{n}{T} \times 100 = \frac{5^2 \times .7854 \times 2}{2.5 \times .5} \times 100 = \frac{393}{1.25} = 314.4 \times 100 = 31.44\%$$

strength of rivets as compared with solid plate.

As a rule it is understood that diameter of rivets may be same thickness as plate, but with thin plates this rule will not hold good, as in the present case it is evident that strength of rivets at joint is far too weak, and it would simply be absurd to construct a joint on these proportions. To increase strength of rivets we must either decrease pitch or increase diameter of rivets. It is considered good practice to have the percentage of strength at the joint or seam 70% of the strength of the solid plate. We can therefore decrease the percentage of strength of the plate by increasing the diameter of the rivet to 3/4 of an inch, and at the same time increase the strength of the rivets.

Then,

$$\frac{P-d}{P} \times 100 = \frac{2.5-.75}{2.5} \times 100 = 70\%$$

percentage of strength of plate at seam as compared with solid plate, and

$$\frac{a}{P} \times \frac{n}{T} \times 100 = \frac{.8834}{1.25} \times 100 = 70\%$$

strength of rivet as compared with solid plate.

It will be readily seen that the most economical joint is one in which the plate and rivet sections are equal in strength. As already pointed out, if one section is stronger than the other it creates a decided disadvantage, as the weakest part of a joint must be its strength, and in a case like the foregoing we might with advantage put half the difference between the strength of the section on to the weakest section.

The easiest way to arrive at this, then, is to equate the formula for the rivet section to that for the plate section:

$$\frac{P-d}{P} = \frac{d^2 \times .7854 \times n}{P \times T}$$

We can now, by a simple transposition of formula, find a pitch that will give equal percentages:

$$P = \frac{a \times \text{No. in one pitch}}{T} + d.$$

Example: What pitch will the rivets of a double rivettted seam have to be so as to secure an equal percentage of strength in rivets and plates at the joints, shell plate being half inch and diameter of rivets 3/4 inch?

$$\frac{d^2 \times .7854 \times 2}{.5} + .75 = \frac{.8834}{.5} = 1.76 + .75 = 2.50 = \text{pitch}.$$

Proof:

$$\frac{2.50-.75}{2.50} \times 100 = 70\%.$$

$$\frac{.75^2 \times .7854 \times 2}{2.5 \times .50} \times 100 = 70\%.$$

I will again repeat these two most important formulæ, and recommend the student to commit them to memory:

$$\frac{(\text{Pitch minus diameter of rivets}) \times 100}{\text{Pitch}}$$

equals percentage of strength of plate at joint, as compared with solid plate, and

$$\frac{(\text{Area of rivets} \times \text{No. of rows}) \times 100}{\text{Pitch} \times \text{thickness of plate}}$$

equals percentage of strength of rivets, as compared with the solid plate.

APPLICATION OF OHM'S LAW.

An examination of the preceding article on Ohm's law establishes three important rules, viz.:

- 1. The current varies directly with the electromotive force or potential, and inversely with the resistance.
- 2. The resistance varies directly with the electromotive force, and inversely with the current.
- 3. The electromotive force varies directly both with the current and resistance.

For practical operating engineers, these rules, based on Ohm's law, are the fundamental principles underlying most electrical calculations. It is important that the principles be thoroughly understood, and I regret that, in a work of this kind, full details

cannot be given, for want of space. Before proceeding to an exposition of these principles by mathematical problems, I wish particularly to point out to my readers the desirability of their acquiring literature dealing with fullest details of Ohm's law.

Bearing in mind the fact that these articles are written especially for engineers operating electric plants, I shall content myself with giving principles and formula especially adapted to their requirements.

It may be well to mention that whatever is included in a circuit forms a portion of it. Be it the generator itself, convertors, meters, or any apparatus in connection with the generation or transmission of an electric current, and the resistance of both line and apparatus, must necessarily be included in resistance of circuit.

The resistance of a generator is nearly always referred to as internal resistance, and that of the outer circuit or line as external resistance, to distinguish between them, and the two resistances added together from the total resistance of the circuit, or the R of the formula.

Example (1): An electric generator having an internal resistance of 5 ohms and an E.M.F. of 50 volts, sends a current through a line of copper wire whose resistance is 25 ohms; what is the current?

$$C = \frac{E}{R}, \text{ then } 5 + 25 = 30 \text{ ohms total } R, \text{ and}$$
$$\frac{50}{30} = 1.66 \text{ amperes.} \quad (\text{Rule 1.})$$

Example (2): A difference of potential (E.M.F.) of 110 volts is maintained in an electric circuit, and a current of 250 amperes is the result. What must be the resistance of the line?

$$R = \frac{E}{C}, \text{ then } \frac{110}{250} = .44 \text{ ohm.} \quad (\text{Rule 2.})$$

Example (3): A generator having an internal resistance of 1 ohm sends a current of 50 amperes through a circuit having an external resistance of 2.5 ohms? What is the electromotive force of the generator?

$$E = R C, \text{ then } 1. + 2.5 = 3.5 \text{ ohms total } R,$$
$$\therefore 3.5 \times 50 = 175 \text{ volts.}$$

MOONLIGHT SCHEDULE FOR DECEMBER.

Day of Month.	Light.	Extinguish.	No. of Hours.
	H.M.	H.M.	H.M.
1....	P.M. 11.10	A.M. 6.10	7.00
2....	.....	" 6.10	6.10
3....	A.M. 12.00	.....	
4....	" 1.30	" 6.10	
5....	" 3.00	" 6.10	4.40
6....	" 4.00	" 6.10	3.10
7....	" 4.20	" 6.10	2.10
8....	No Light.	No Light.	1.50
9....	No Light.	No Light.	.....
10....	No Light.	No Light.	.....
11....	P.M. 5.00	P.M. 8.40	.....
12....	" 5.00	" 8.40	3.40
13....	" 5.00	" 9.40	3.40
14....	" 5.00	" 10.50	4.40
15....	" 5.00	A.M. 12.00	5.50
16....	" 5.00	" 1.00	7.00
17....	" 5.00	" 2.00	8.00
18....	" 5.00	" 3.10	9.00
19....	" 5.00	" 4.30	10.10
20....	" 5.00	" 5.50	11.30
21....	" 5.00	" 6.10	12.50
22....	" 5.00	" 6.10	13.10
23....	" 5.00	" 6.10	13.10
24....	" 5.00	" 6.10	13.10
25....	" 6.00	" 6.10	13.10
26....	" 6.00	" 6.10	12.10
27....	" 6.00	" 6.10	12.10
28....	" 6.00	" 6.20	12.10
29....	" 6.00	" 6.20	12.20
30....	" 6.00	" 6.20	12.20
31....	" 6.00	" 6.20	12.20

Total..... 229.50
Grand total..... 2187.25

Specifications have been prepared by Mr. George White-Fraser, of Toronto, for the electric light plant to be installed at Fort William, Ont.

I. J. Gould, of Uxbridge, Ontario, is equipping his plant for the supply of incandescent lighting, and has made a contract with the Canadian General Electric Company for a 30 kilowatt single phase alternating plant.

TRADE NOTES.

Belding, Paul & Co., of Montreal, have ordered a 25 k.w. generator from the Canadian General Electric Co.

Capt. Mann, of the Hillsdale Conservatory, has purchased a thirty horse power boiler from the Goldie & McCulloch Company, of Galt.

The Canadian General Electric Company are installing an isolated direct current plant for the Raymond Mfg. Company, Guelph.

The Canadian General Electric Company are installing a 60 kilowatt single phase alternating incandescent plant in the town of Magog, P.Q.

The Clayton Air Compressor Works, of New York, have issued a very complete catalogue of their air compressors, containing numerous illustrations, tables and testimonials.

The Canadian General Electric Company are installing a single phase alternating plant for incandescent lighting, for Jacob Morley, of New Hamburg, Ont.

The attention of our readers is called to the announcement in our advertisement pages of the Victoria Tripolite Co., of North Sydney, C.B. This company manufacture Victoria Fossil metal

covering for boilers, pipes and all heated surfaces. Their claims for the advantages to be derived from using this material are supported by testimonials of a number of well-known manufacturing concerns.

The Canadian General Electric Co. have sold a 17½ k.w. steel frame multi-polar dynamo to the Ottawa Gold & Silver Mining Co., of Keewatin, Ont.

Messrs. Duclos & Payan, St. Hyacinthe, Que., have ordered a 200 light direct current incandescent plant from the Canadian General Electric Company.

The large Brodie mills at Hespeler, Ont., are to be lighted by electricity, a contract for a 140 arc light plant having been given to the Stevens Mfg. Company, of London, Ont.

The Robb Engineering Company, of Amherst, received a cable from England a fortnight ago ordering three more Robb-Armstrong engines. They are, it is thought, for a new electric railway in Sheffield.

La Cie Electrique de Roberval, Chicoutimi county, Quebec, have placed an order with the Canadian General Electric Company for a 60 kilowatt single phase alternating machine of the company's standard iron-clad armature, compound type.

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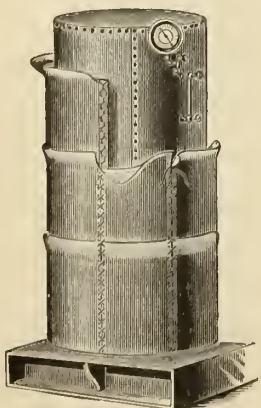
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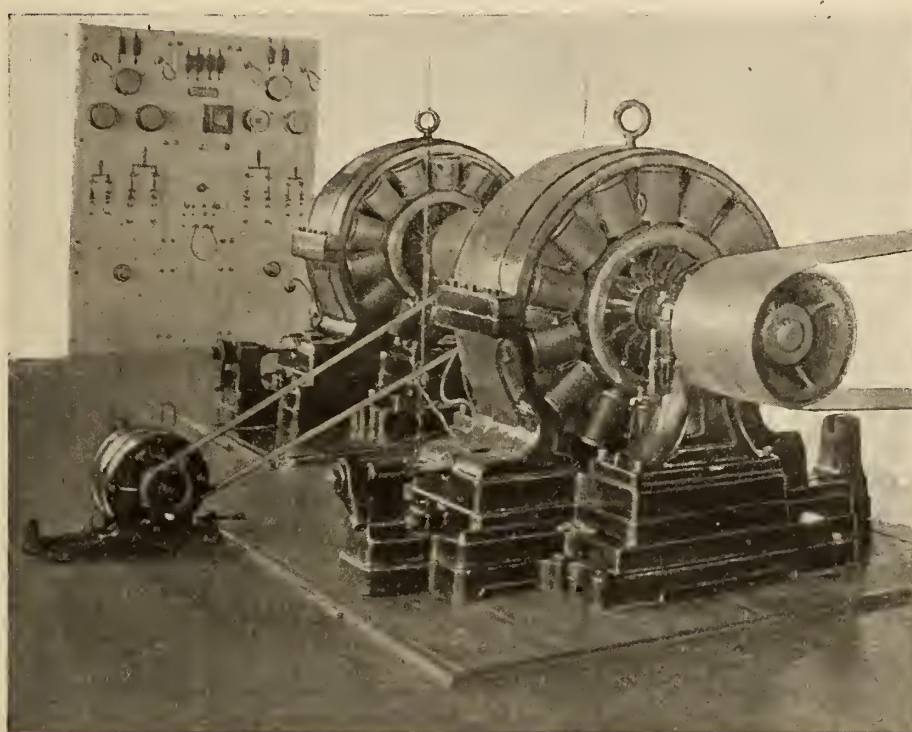
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SPARKS.

Instruction in electricity is now given by the Y.M.C.A., Hamilton, Mr. Hamilton being instructor.

The contract for lighting the village of Glencoe, Ont., by electricity has been awarded to W. Gordon.

The Valleyfield Electric Company have ordered two 500 light direct current generators from the Canadian General Electric Company.

The city council of Montreal is taking action against the Montreal Street Railway Company for not having built their line up the Côte des Neiges Hill.

Mr. George White-Fraser, of Toronto, has submitted a proposition to the town council of Orillia, Ont., to supply the town with electric light and power from the falls at Washago.

The Whitney Electrical Instrument Company, of Penacook, N. H., and Sherbrooke, Que., have transferred the manufacture of their apparatus for Canada to Mr. C. E. Shedrick, of Sherbrooke, Que., who will have full control of the manufacture and sale of the well-known Whitney electrical instrument.

The services of Thomas Gisborne, superintendent of Dominion government telegraph lines in the Northwest and British Columbia, have been dispensed with on the grounds of efficiency and economy.

The Sherbrooke Gas & Water Co., of Sherbrooke, Que., are making extensive additions to their incandescent lighting system, and have added another 180 k.w. S.K.C. machine to their plant. They have now two 180 k.w. and two 60 k.w. S.K.C. machines, from which they are furnishing both light and power.

Mr. F. S. Barnard, managing director of the British Columbia Electric Railway Co., Limited, has closed a contract to furnish power to the Esquimalt Waterworks Co. A power house, with Pelton water wheels and generators, will be erected at Goldstream, at which point the waterworks company will furnish the electric railway company with a sufficient quantity of water under an effective working head to develop electric power. The power will be transmitted a distance of twelve miles to the sub-station of

the company in Victoria, and there stepped down and applied to the various purposes for which it is required.

The Duryea Motor Company, now known as the Canada Manufacturing Company, of Cataract, N. J., are endeavoring to manufacture the Duryea motor in Canada. A company has been formed, with a capital of \$250,000. The promoters are S. F. McKinnon, Geo. W. Yarker, Samuel Rogers, Timothy Eaton, and H. E. Ficken, all but the last named being Toronto men.

John Phillip, of Grand Valley, who has heretofore been operating an arc and incandescent lighting plant in that town, has decided to go into electric lighting more extensively, and for this purpose has purchased from the Royal Electric Company one of their S.K.C. two-phase alternating current generators with 300-light capacity of transformers and supplies. The work of construction is being proceeded with.

The annual statement of the Montreal Street Railway Company showed the total net earnings for the twelve months ending September 30th last to be \$507,885.60. Out of this a four per cent. dividend was paid in May last amounting to \$160,000, and another in November of 4 per cent. amounting to \$166,666.67. With the latter was a bonus of \$41,666.66, making a grand total of \$368,333.33. This leaves a surplus of \$139,552.27, which, when added to last year's surplus, gives a total of \$340,245.51. During the year the company carried no less than 32,000,000 passengers.

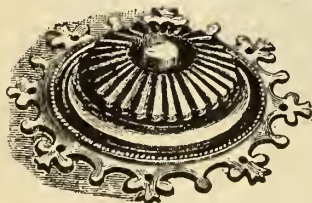
The Deschenes Electric Company, Limited, have taken out a license to supply electric light and power in the city of Ottawa and county of Carleton. The above company was organized in July last, under a Dominion charter granted in January, 1896. The directors are: Messrs. W. J. Conroy, R. H. Conroy, Alex. Fraser, David Maclaren and Charles Magee. Mr. W. J. Conroy is president and Alexander Fraser vice-president. The company obtained a lease from the Dominion government to lay cables from the Ottawa river, at the foot of the locks on both banks of the Rideau canal, to the canal basin and head of the deep cut. For this privilege they will light up the canal free.



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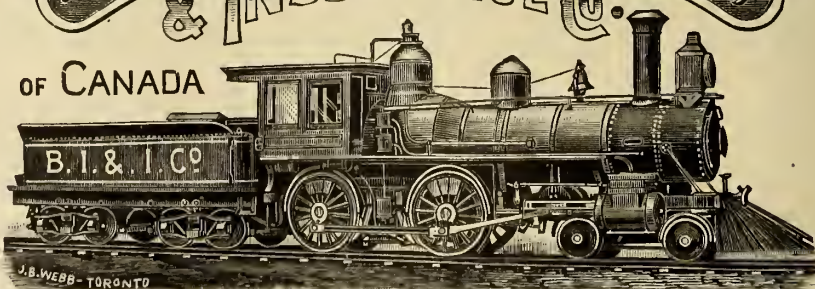
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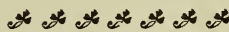
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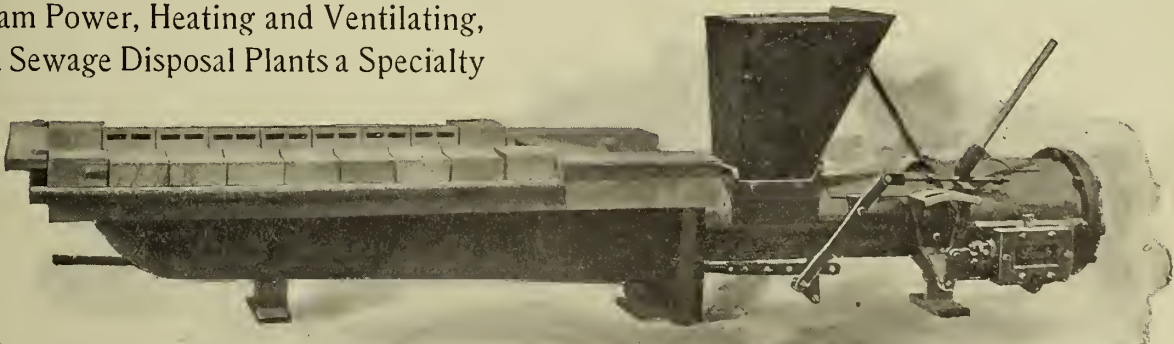
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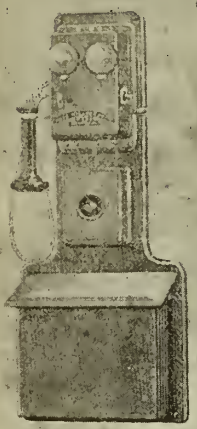
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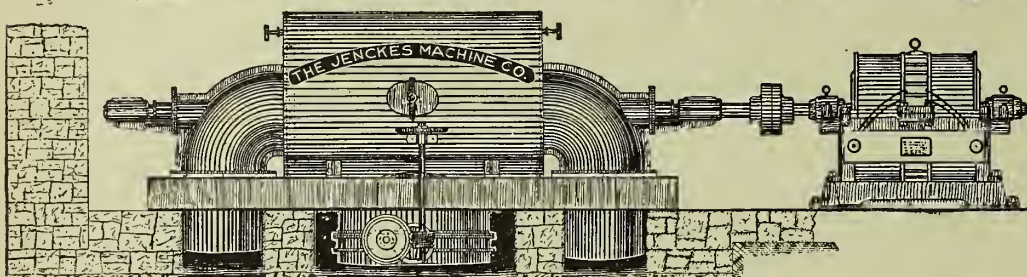
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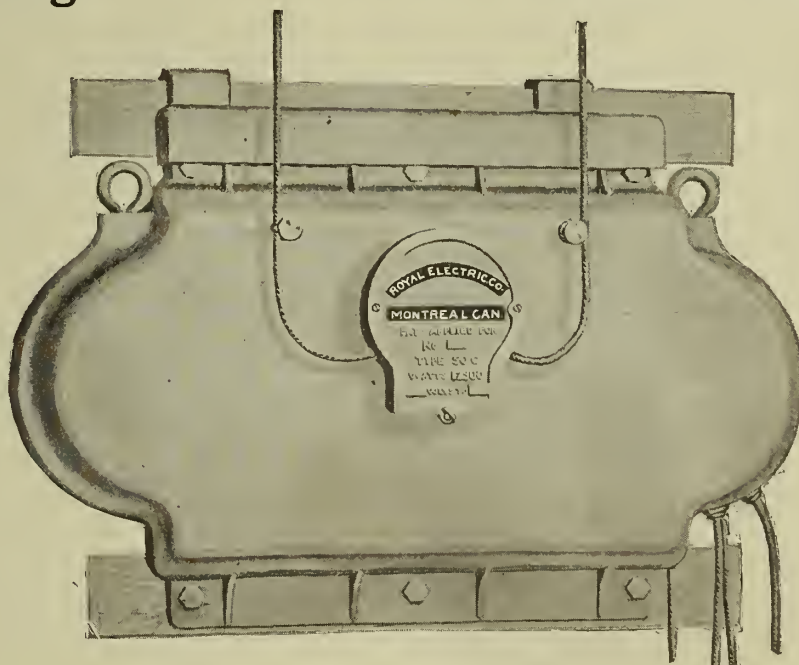
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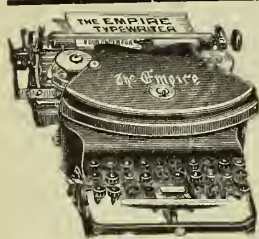
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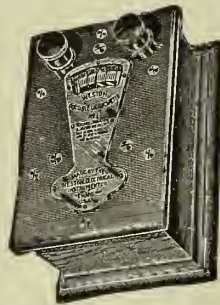
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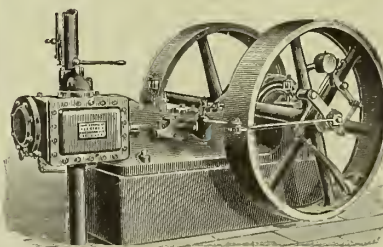
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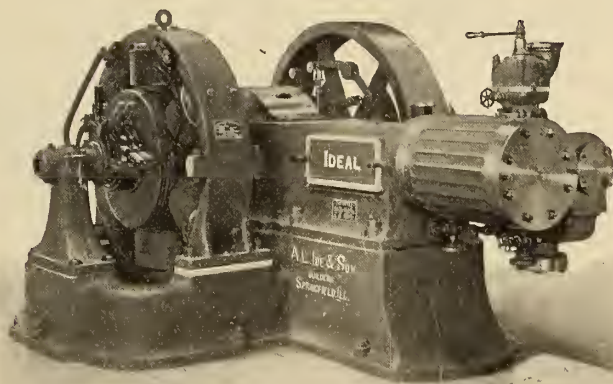
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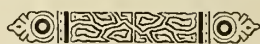
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CANADIAN
ELECTRICAL NEWS
AND
STEAM ENGINEERING JOURNAL.

VOL. VII.

DECEMBER, 1897

No. 12.

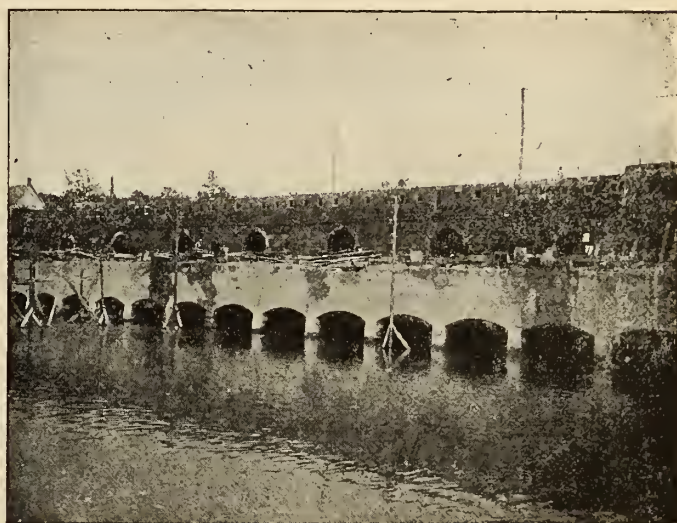
THE CHAMBLY ELECTRICAL POWER TRANSMISSION PLANT.

ALMOST phenomenal have been the strides made in Canada of late years in the development of water power for the generation of electricity. In several instances the power has been transmitted many miles, this being rendered feasible by the perfecting of means by which very high potentials can be controlled with absolute safety. Descriptions of the transmission plants of the Lachine Rapids Hydraulic and Land Company at Montreal, and the North Shore Power Company at Three Rivers, Que., have already appeared in the *ELECTRICAL NEWS*, and in the last number reference was made to the proposed works of the Cataract Power Company, of Hamilton, now in course of construction. In each of these plants engineering practice of high order and of special character has been called into requisition. Of equal importance, both from an electrical and hydraulic engineering standpoint, is the scheme of the Chamby Manufacturing Company, which is now being carried to completion, and which embraces many special features. The following description of this interesting installation, for which we are indebted to the *Electrical World*, will give a fair conception of the completed work :

At Richelieu village, about 25 miles distant from Montreal, the Richelieu River falls through a long series of rapids. From early days a wooden dam between Richelieu village on the one side of the river, and Chamby on the other, has been in existence, supplying power to a few small mills. The new structure which takes its place is one of the finest examples of hydraulic engineering on the continent, consisting of a massive

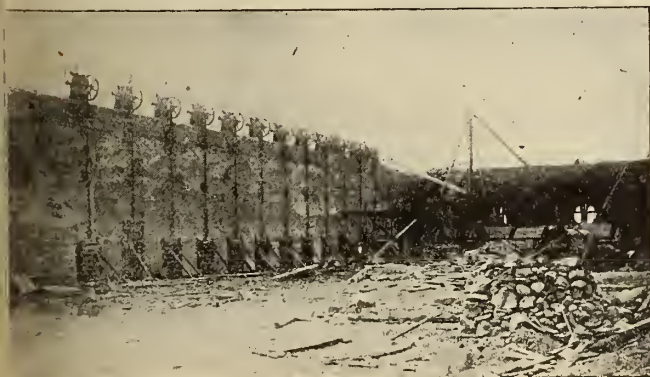
destructive washing action at the base. A liberal use of one-half inch iron rods, incorporated with the mass of the concrete, gives great strength to the structure, and a surface dressing of neat cement insures the greatest impermeability. This is said to be not only the most carefully constructed, but also the largest concrete dam on the continent.

The dam consists of three portions, two of which run



TWO-STEP DAM FROM BELOW, SHOWING TAIL RACES AND FLUMES.

perpendicularly across the course of the river, while the third and middle part is parallel with it. In the lower third of the dam, and near the right bank of the river, is built the power house. Here the dam consists of two levels, or steps, over which is built a structure of steel beams and brick walls, 308 by 51 feet, for the protection of the machinery. The upper level, which is about two feet above the surface of the water in the lake formed by the dam, will contain the switchboards and controlling devices, and such offices as are necessary. In this part of the dam, eight rooms, or flumes, each about 20 feet square and 10 feet high, are constructed, their arched openings being under the water level, for the reception of the wheels. These, of the horizontal-shaft pattern, number four in each flume, each wheel being 46 inches in diameter. These wheels are mounted tandem on one shaft in two pairs, between the wheels of each pair being a large cast-iron box communicating with the draft tubes, which extend through the solid concrete of the lower step of the dam to a point below the level of the tail water. The draft tubes are built of sheet steel, and are 9½ feet in diameter where they leave the boxes, and 10 feet at their outlet. The upper extremities of these being one behind the other in the line of the shaft, necessitated their construction in a curious skew curve. This installation seems to run to superlatives, since these draft tubes are the largest ever



THE WASTE GATE FROM THE FORE BAY.

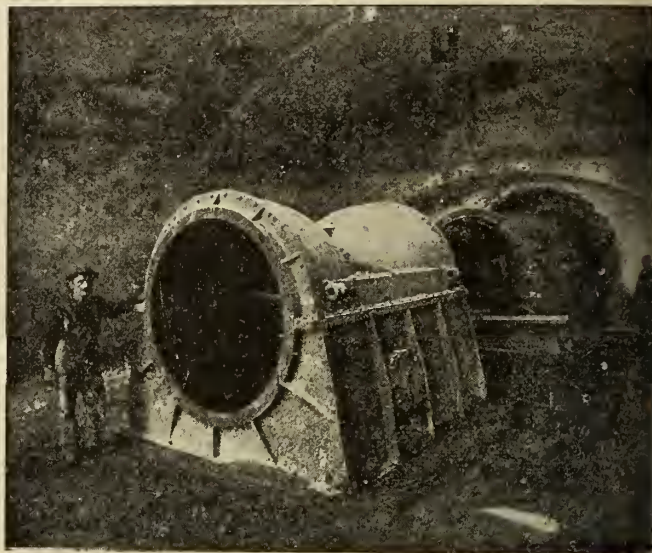
concrete dam, in which, as an integral part, is built the power house, with a capacity of 20,000 horse power. This dam is about 2,000 feet long, 6 feet wide at the crest, and constructed of a concrete composed of the broken rock of the river bed, mortared with sand from the vicinity and American cement. The back is vertical throughout, and the apron is curved so that the overflow water is discharged horizontally, obviating any

constructed. Their bedding in concrete excludes all possibility of leakage, and it is confidently expected that the full advantages of the head of 28 feet will be realized by their use, although the wheels are but a few feet below the level of the intake water. Under this head, and at the speed of 153 revolutions per minute, each wheel will develop 660 horse-power, or a total of 2,640 horse-power to each shaft and flume.

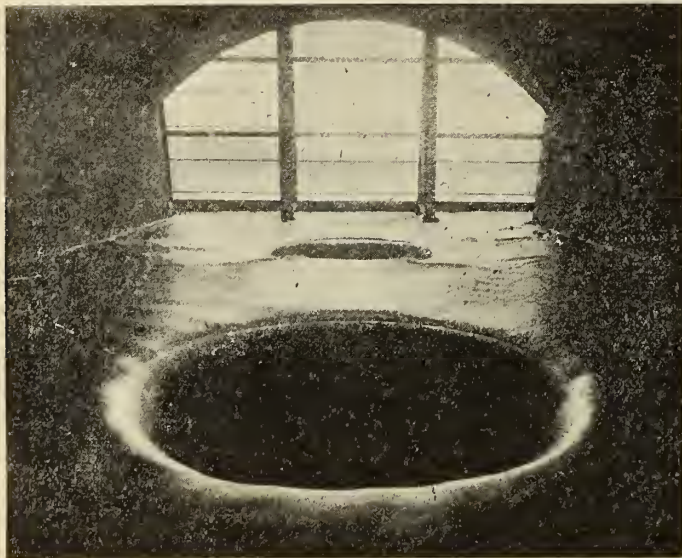
The governing of the wheels will be by means of Giessler electro mechanical governors, similar to those in use at the Lachine plant. These are relay governors, the revolving balls actuating a small lever which closes electrical contact at speeds higher or lower than that for which the instrument is set. These contacts control electro-magnets which operate clutches on the main shaft geared to the gate of each gang of wheels. It has proven an excellent and reliable governor in other large hydraulic installations, notably in that at Lachine Rapids.

At present only four of the eight sets of wheels are being installed, together with two 28-inch wheels, giving 750 horse power for driving the exciters of the large dynamos. The whole of the hydraulic machinery was

the power house dam, a large conduit has been made for the reception of the leads from the dynamos to the switchboard. Lead-covered, rubber-insulated cable will be used for these. In the walls of the power house a number of large terra-cotta pipes, about 3 feet long,



CASINGS FOR FOUR TURBINES IN PLACE IN FLUME.



FLUME AND DRAFT TUBES BEFORE TURBINES WERE SET.

furnished by the Stillwell-Bierce and Smith-Vaile Company, of Dayton, Ohio, and reflects much credit upon that concern by the solidity of its construction and the great accuracy with which the parts of the heavy wheels and draft tubes were assembled at Chambly by its constructing engineer, Mr. H. A. Wright.

The shaft of each gang of turbines passes out horizontally through a circular steel bearing plate on the down-stream vertical face of the upper step of the dam, and is directly connected to a 2000 k. w. generator, giving two-phase current at 60 cycles per second and 12,000 volts.

These machines are of the inductor type, having no moving wire. The inductor is about 10 feet in diameter, and of very massive construction. The single-circular field coil is wound on a brass spool of about 10 inches face by an equal depth, and completely surrounding the inductor. The armature is in two parts. The insulation of these armatures is necessarily most massive and substantial. All the dynamo machinery is now under construction by the Royal Electric Company, at Montreal, from designs by the Stanley Electric Manufacturing Company, of Pittsfield, Mass.

In the space above the flumes in the upper portion of

bent to a quarter circle, with the convexity upwards, have been built in, and through these the cables leading to the pole line will pass out without touching anything between the insulators inside and outside the building.

Two pole lines will be constructed to Montreal, either one being sufficient to carry the load. This construction was adopted to minimize the chances of accidental breakdown, and to make repairs easily possible without danger to workmen. The poles are of chestnut, none being less than 40 feet long. Each pole carries two cross arms, the usual "square" for two-phase transmission being observed. The insulators are of a deeply petticoated porcelain type, somewhat similar to the Niagara pattern, but lacking the grooves for conducting away rain water. They are mounted on oak pins, having a steel rod in the center of each. A line of



BUILDING THE UPPER STEP OF POWER-HOUSE DAM, SHOWING MANHOLE TO FLUME AND ENTRANCES TO CABLE WAY.

barbed wire is run along the tips of the poles, and four similar lines are attached at the ends of the cross arms, all five being connected together and grounded by means of 8 feet of iron gas pipe at each pole. The line wire is bare, of 00 gauge, and is tied to the insulators by two pieces of No. 12 gauge soft copper wire. A short dis-

tance below the main line a short cross-arm carries the two No. 12 copper wires of a telephone circuit.

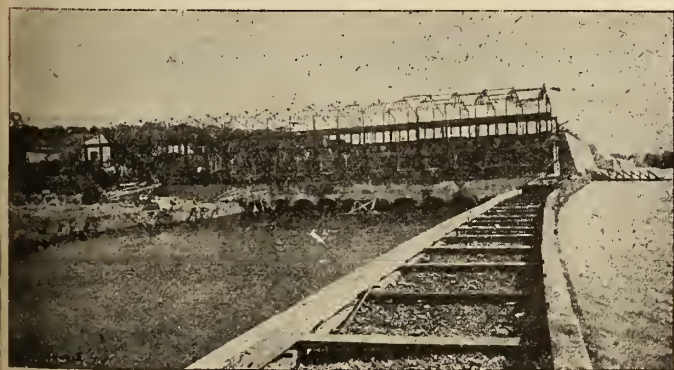
The main power transmission line will end in the electric light station of the Royal Electric Company, at Montreal, where 6,000 horse power will be used for incandescent and arc lighting and direct-current motor



LOOKING DOWN LOWER STEP OF DAM.—POWER-HOUSE FRAMING.

service. The large two-phase generators now employed in that plant for incandescent lighting and power will be re-wound as synchronous motors, and connected directly in the 12,000 volt circuit. These machines will then be belted by a system of countershafts to the arc-light generators and other continuous current machines of the station, to which they will furnish power. A group of static transformers of 150 kilowatts each will be arranged in the basement of the present station, reducing the line voltage of 12,000 for distribution over the present circuits at 1000 and 2,000 volts, two-phase.

The transformers are now under construction at the works of the Royal Electric Company, in Montreal. Their greatest feature of novelty is in the method of cooling employed. The transformer is set up in an iron case in the usual way, this being filled with oil for insulation, and the whole surrounded by a sheet iron water jacket. As the plant in Montreal is some feet below the



LOOKING UP THE TAIL RACE TOWARDS THE POWER HOUSE.

level of the Lachine canal, from which water is obtained under a small gravity head, the water going to the condensers will be allowed to circulate around these transformers in the jackets, and it is expected that this arrangement will result in very effectual cooling.

The troubles with ice, which have been so long a bugbear to many Canadian plants, are not expected to be at all serious at Chambly. The back water from the great dam will make a lake of still water at least $1\frac{1}{2}$

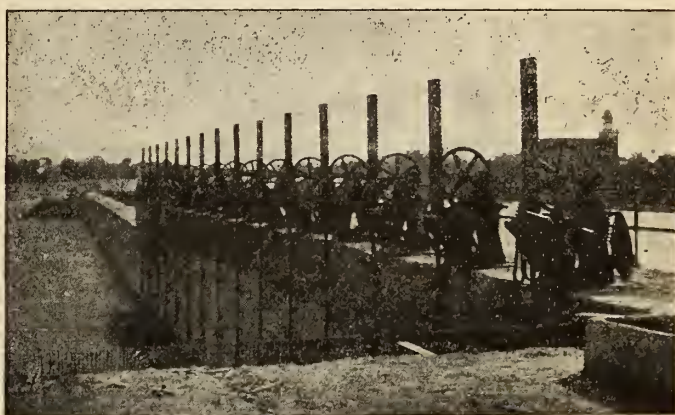
miles long up the river, and, as this will freeze over the surface at the beginning of the season, no trouble whatever is expected from anchor ice. It is expected that floating ice in the spring thaws will clear the dam without trouble. It is a peculiarity of the Richelieu River, which is the outlet to Lake Champlain, that its current is comparatively steady throughout the year, and consequently no difficulties with freshets or low water are anticipated. The construction of the dam and other elements of the power development reflect great credit upon the engineer of the Chambly Manufacturing Company, Mr. J. G. Macklin. The work is progressing at an extremely rapid rate, and the contracts call for the installation of all the hydraulic machinery and the completion of the dam by January 1 next. One of the dynamos is finished and the others are well under way, so it is likely that current will be turned on from this installation in the early spring.

It is expected to deliver nearly 20,000 electrical horse power from this plant in Montreal when the total equipment is installed at Chambly. This will make a grand total of nearly 40,000 horse power sent to that city from two great water powers.

HOW TO MEASURE.*

By W. H. BALLARD.

IN measuring anything it must be compared with a standard, the measurement of which is known.



WASTE GATES.

Examples of common standards are pounds, yards, etc. Although it is generally the case, it is not necessary that that which we measure is greater than the standard. In measuring a surface or area, we take a small portion of the surface (it may be anything, a square foot, yard, etc.) and compare the extent of the whole surface which we do not know with that which we do know. For instance, take a surface 12 ft. square and mark off one square yard in the corner; four of these squares would reach from one side to the other and form a strip one yard wide, and if this strip is repeated until the whole surface is covered, the measurement of the area will be found by multiplying the number of strips by the number of square yards contained in each. No matter how far extended the surface may be, it is measured by this process. Whatever you start multiplying by the result must be; if by feet the result will be in feet, and if by yards the result will be in yards. The same principle is used in measuring any figure, large or small. To take a proportion we have to start with something which we definitely understand. In measuring solids we start with the cubic inch, foot or yard.

This brings us to the second point. In the first place

* Paper read before Hamilton Association No. 2, C. A. S. E., by Mr. W. H. Ballard, Inspector of Schools.

it was shown that measurement consists in comparison. Secondly, it consists in comparing with something else of the same kind. If weight is to be measured it must be compared with a certain definite understood weight, such as pounds, etc. Value is measured by the dollar; area by the square foot or square yard; volume by cubic inches, feet or yards; length by something which contains a certain known length; if any moving object passes through a certain space in a certain time it is a measure of velocity. The surface of a cone is measured by multiplying the slant line by half the surface of the base. To find the cubic contents of a cone, first find the area of the base and go through the process of finding the volume of a cylinder, then divide by three, as a cone equals exactly one-third of a cylinder.

A simple way to find the height of a smokestack is by measuring the length of its shadow and comparing it with the shadow of some object of which we know the length.

The imperial standard of measurement is a bar about 40 or 42 inches long at two points, on which there are two gold plugs, and the difference between these plugs is the imperial yard. In all measurement of length the yard is the standard. Measurements were originally made by comparing objects with parts of the human body, such as the length of the hand, etc., and land was measured by the length of the footstep. The standard of weight is made to depend on the standard of time. All measurements have reference to the three fundamental units—time, weight and length.

MR. HARRIS P. ELLIOTT.

It is with pleasure that we present in this number a portrait of Mr. Harris P. Elliott, who has recently been appointed to the position of Lecturer in "Electricity" and "The Steam Engine" at the Toronto Technical



MR. HARRIS P. ELLIOTT,
Lecturer in "Electricity" and "The Steam Engine,"
Toronto Technical School.

School, in succession to Mr. James Milne. These two courses of the School are very largely attended, and good work is being accomplished.

Mr. Elliott, the new appointee, was born at London, Ont., in October, 1875, his father being of English descent. He entered the School of Practical Science, Toronto, in 1891, and during the following summer was engaged by Messrs. Mallock & Fairbairn, manufacturers of elevators, London, Ont. In the fall he again entered the School of Science for a second year, but on account of illness was compelled to give up his studies. He was then employed for a year by the Canadian General Electric Company in London. He finished

the second year at the School of Science in 1894, and during the summer was engaged upon the engineering staff of the London street railway, in the construction of their Springbank line, under Mr. Kenneth Mackay.

The following year Mr. Elliott took his third term at the school, graduating with honors in 1895. An engagement was then obtained with Dr. Samuel T. Tracey, of New York, handling X rays apparatus. In the college season of 1896-97 he took a post-graduate course, obtaining the degree of B.A.Sc. from Toronto University, with honors. During the past summer he obtained a position on the engineering staff of the Fort Pitt Bridge Company, of Pittsburg, Pa., tendering his resignation to assume his duties at the Technical School.

Mr. Elliott is a nephew of the Hon. Mr. Justice Proudfoot, of Toronto. By his ability and energy the efficiency of the departments under his supervision will no doubt be maintained.

THE PROPOSED STEAM BOILERS ACT.

TORONTO, Dec. 3rd., 1897.

To the Editor of the CANADIAN ELECTRICAL NEWS.

SIR,—In your November number I see a letter signed "Acadian Engineer," concerning a bill entered at the last session of the Dominion Parliament, in which he takes exception to one of the clauses. The engineers in the west have for several years done considerable work along this line, and we are pleased to hear from our eastern members of the profession, even if it is only to give us his opinion of where we were wrong. There is no doubt but a bill drawn upon the lines he speaks of would be an excellent arrangement for those who have had some technical education as well as some experience, but it would be very hard upon men who had safely operated steam plants for years without knowing exactly what the safe pressure or the tensile strength of the material was. If such a clause was passed what would thousands of our factories do for an engineer? Simply shut down until such a man could be found. I am afraid that if such a law was asked for it would not receive many votes in the House of Commons. A law to be useful must be framed in such a way as not to greatly interfere with present commercial practice, and necessary changes be brought on gradually. Here in the west it has been our experience that it is very much easier to amend a law than it is to get it on the statute books.

What we require is that the government should see and understand the necessity of having steam boilers under the care of accredited men. Once we get this thoroughly established, a law should be enacted that will bring the desired end without hardship to the owners of steam plants. I think if the matter is put into the same position as the steamboat men were at the passing of the Steamboat Act in 1868, we would then have every man now operating a plant secure a certificate to run the plant at which he is employed, and if he should want to operate a larger plant he would have to pass an examination before he could do so. This would have the effect in a few years of raising the standard of knowledge required to operate our steam plants. The western engineers are alive to this, and will be very much pleased to have the fullest assistance possible to get a law passed, and we will never complain if it is as stringent as "Acadian Engineer" says it ought to be.

Yours respectfully,

TORONTO ENGINEER.

The corporation of the city of Lachine are installing in their power house one of the Royal Electric Co.'s 2,000 light alternators.

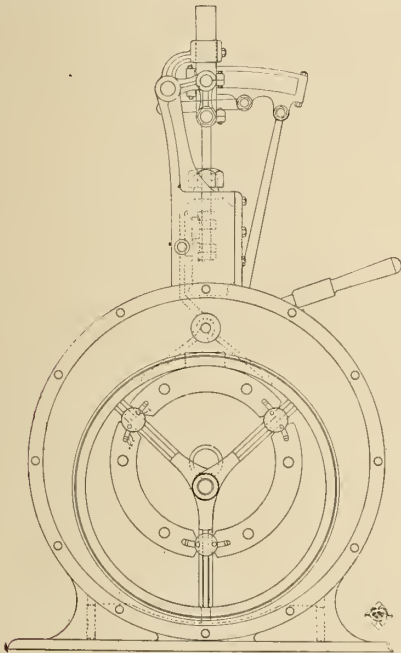
Mr. Geo. Hartman, of Peterborough, in renewing his subscription to the ELECTRICAL NEWS, writes: "I find it very useful and should not care to be without it."

Mr. J. W. Cochrane, of the Glenboro Roller Mills, Glenboro, Man., under date of Nov. 2nd, wrote the Dodge Pulley Co., of Toronto, as follows: "You should see our rope drive; it is just the slickest thing I ever saw in the way of a drive. If you have any prospective customers for a drive, just refer them to me, will you?"

THE TREE ROTARY ENGINE.

MESSRS. Baird & Tree, of Woodstock, Ont., have recently been granted a patent for, and are now manufacturing, a new and improved rotary engine embodying many points of merit. The manufacturers claim that it is especially adapted for service in connection with electric lighting plants, and where economy of space is a consideration, as it only occupies from one-tenth to one-quarter that of the ordinary engine. It is also much cheaper to build. In the accompanying cuts the two elevations of the engine are shown.

Some of the most important features of the Tree rotary engine are: The double casings (the inner ones revolving with the wings inside and being fastened to and a part of the ring piston), which casings almost entirely do away with the friction that has been one great cause of failure in many rotary engines heretofore; a bearing on both ends of the ring piston, one fastened to the main shaft, the other revolving on a stationary shaft, with an offset inside the ring piston casing, making the ring piston shaft; the automatic adjustable metal packing around the wings and wing swivels, the double ring packing between casings and main chamber coming right to the corner of the cylinder, and the automatic adjustable packing between the ring piston proper and the top part of the steam chamber, making the whole engine absolutely steam tight, and thus overcoming another of the difficulties in former rotary engines, viz., steam tightness. The exhaust at the large part of the cylinder gives a forward pressure and a supplemental exhaust at the top, both of which are new. The three intakes of steam for the wings, made



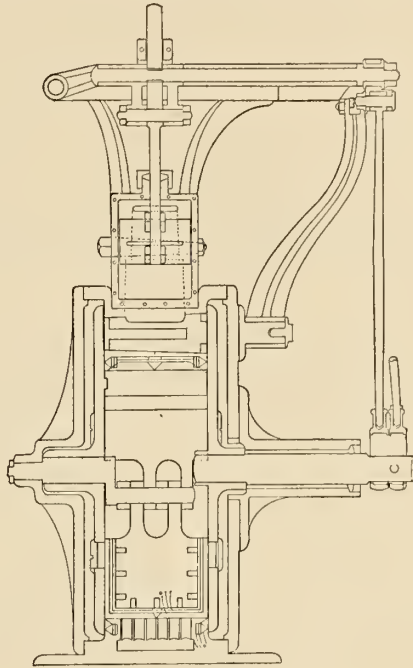
THE TREE ROTARY ENGINE.

with one up and down motion of the valve, utilizes expansion to a much greater degree than the ordinary engine could possibly do, on account of the first part of the cylinder being small. This utilization of expansion is claimed to be the first attempt ever made on a rotary engine that has been successful. Another important feature is the reversing device in connection with the ordinary link motion, making a perfect reverse, and controlled with one lever. All of the above points are believed to be strictly new.

On account of the high speed that is enabled to be attained, it can be connected directly to the shaft of any dynamo, thereby saving friction of pulleys and belting,

which means economy of steam. The friction is so light that the durability of the engine is certain to be great.

The first part of the cylinder being small where high pressure live steam is used, and the balance of the cylinder increasing in size as the steam expands and gets weaker, and the leverage increasing at the same time, the average pressure on the ring piston is always the same; and the second wing taking the live steam again before the preceding one exhausts, makes the pressure continuous, and, of course, the absence of all



THE TREE ROTARY ENGINE.

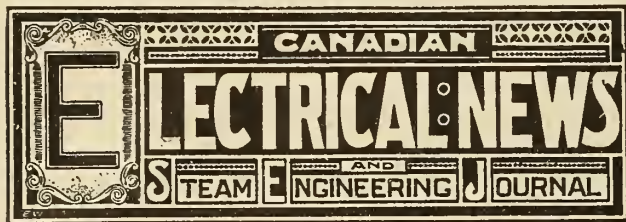
reciprocal motion gives the engine a perfectly steady speed.

The manufacturers have already lifted 18 h. p. with an ordinary 12 h. p. boiler running only 600 revolutions per minute. The engine complete, pulley, balance wheel, and bed plate, only occupies two feet square and $8\frac{1}{4}$ inches in diameter inside, 4 inches wide, and only using $1\frac{1}{2}$ inches on the average of the outside of the $8\frac{1}{4}$ inch cylinder. They have used an engine of this size from the 1st of May to the present time, and are now running one ten ton lathe, two smaller lathes, one shaper, two large press drills, emery wheel, etc., in their work shop by this engine. They are building a 75 h. p. engine, which they expect to complete in a few weeks. A test of this engine will be made at the School of Practical Science, Toronto, or at McGill University, Montreal, and the results published.

Persons desiring further particulars of this engine should communicate with the manufacturers, Messrs. Baird & Tree, 39 Finkle street, Woodstock, Ont. Their factory is always open to inspection, and visitors are assured of a cordial reception.

Application will be made for the incorporation of the St. Lawrence Foundry Company, to develop water powers and furnish electric light and power in the province of Quebec.

A trial trip of Heilmann's electric locomotive was made on November 13th, the route being from Paris to Nantes. The train hauled by the locomotive weighed about 200 tons. The speed did not exceed sixteen miles an hour. The principle of the locomotive is simple, an ordinary steam engine working a dynamo, the electricity being conducted to motors upon the axles of eight pairs of wheels. The locomotive resembles the hull of a torpedo boat. It is 18 metres long and weighs 125 tons. It is regarded as a great improvement on Heilmann's first engine, and the directors of the railway are said to have decided to adopt it.



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Correspondence is invited upon all topics legitimately coming within the scope of this journal.

The "Canadian Electrical News" has been appointed the official paper of the Canadian Electrical Association.

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Fuel Economy With Locomotives. THE work of compounding the locomotives in use on the Canadian Pacific Railway lines was begun a few months ago at the company's workshops in Montreal, and is being proceeded with as rapidly as possible. The compounding of these locomotives is said to have reduced the expense per running mile from six to three cents.

Wattage of Lamps. THE wattage of lamps is a matter in which a saving might be effected by central stations. Lamps can be obtained of 60, 54 or 50 watts each. In an average 1,000 light plant probably an average of 6,000 lamp hours per night are supplied. The difference between using 50 watt lamps and 54 watt lamps is 24,000 watt hours nightly, which is almost 50 horse power hours. Putting this at its coal equivalent shows that 50 watt lamps will save about 23 tons yearly over 54 watt lamps, and at \$3 this means \$69 yearly. In order to use 50 watt lamps it is absolutely necessary to have a very close voltage regulation, and this can be effected by a liberal use of copper and careful attention. Five per cent. interest on \$1,400 is \$70, and this liberal use of copper will not cost \$1,400, so that a net saving will result, not to speak of the increased lamp capacity of the machine.

The Power Question in Toronto.

SOME peculiarly interesting questions, having a bearing on electrical matters, have recently come before the City Council of Toronto for consideration, and it seems rather a cause for regret that they have not received a more careful and thorough discussion. The most advantageous, that of lighting and furnishing elevator power for the new city and county buildings, has for long been a cause for not only discussion, but even dissension, among the many advocates of different

methods. As to whether the power shall be purchased from the Toronto Electric Light Co., or generated by a plant placed in the buildings themselves, or by a plant placed in the waterworks pumping house, is a question which cannot be solved by the application of purely general principles without regard to the particular conditions. The Toronto Electric Light Company is, of course, desirous of obtaining the contract, and offered the very reasonable price of 3 cents per k. w. h. It seems doubtful whether the current can be generated in the buildings themselves for such a figure.

Electrical Development.

WITH this number of the ELECTRICAL NEWS the seventh volume of the new series is completed. Taking a retro-

spective glance over the past twelve months, we must conclude that in some respects the year has been one of phenomenal advancement. Perhaps the greatest work has been accomplished in the utilization of water powers for the generation of electricity, in which direction Canada is rapidly coming to the front. The Chambly transmission plant, a description of which appears in this number, possesses engineering features quite on a par with those of the Lachine Rapids installation, while it is not lacking in unique features also. The magnitude and necessary efficiency of these undertakings have naturally called into requisition the employment of the very best machinery, and our Canadian manufacturers of electrical apparatus have demonstrated beyond a doubt their ability to meet the requirements in this respect. Of the prospect for the electrical business we are most sanguine. It would appear that we are on the eve of an electrical era, when electricity will be employed for purposes for which it was never thought of a few years ago. It promises to be utilized for the supply of power, in mining operations, for cooking and heating purposes, and in many fields that will increase its usefulness. With improved commercial conditions such as are likely to be experienced in the near future, the outlook for the electrical industry is quite hopeful.

Advantages of Radial Railways.

IN discussing the question of the enlargement of St. Lawrence market in Toronto, Ald. Lamb referred to the

benefits to be derived by the city and vicinity from the construction of radial railways, and pointed out that steps should be taken to induce the building of such roads. We presume that Ald. Lamb had in mind railways operated by electricity, which has proven to be the most economical and satisfactory system for short distance lines. In this respect, considering her commercial importance, Toronto does not compare favorably with other cities in the province. Hamilton is surrounded by suburban roads, each of which is believed to be a paying investment and to have assisted in building up the city. A system of radial railways would undoubtedly prove of equal, if not greater, benefit to Toronto, and every encouragement should be given to legitimate enterprises of this character. The failure of the Grand Trunk Railway Company to successfully operate the belt line road constructed around Toronto a few years ago has probably tended to discourage investment in radial railways. This, however, should not be the case, as the failure of this road, which was operated by steam, was attributable to causes which do not apply to electric railways. We are pleased to learn that a company is now seeking authority to purchase

existing roads, and to build new ones in the County of York, and that the charter includes the taking over of the G. T. R. belt line above referred to.

Candle Power of Arc Lamps.

WE have already had occasion to refer to the candle power of arc lamps, and the very indefinite way of specifying it.

It seems to have become fixed in the minds of a large number of persons that a 9.6 ampere arc lamp will give 2000 candle power, and that a 6.8 ampere will give 1200 c. p. When, therefore, such lamps are put in a circuit, and seem to give a light deemed not up to their standards, disappointment and dissatisfaction result. The manufacturing companies are blamed for trying to sell under worthless guarantees, and the customer considers himself badly treated. Now, it is not the business of this journal to take the part of manufacturers against the public, but we deem it in the true interests of the electrical industry to point out to our operating readers that the above dissatisfaction is most emphatically largely their own fault. A man who does not take the trouble to study the details of a business out of which he makes his living almost deserves to be deceived, more especially when the whole literature of the subject is at his disposal, is extremely interesting, and written in a state to suit not only the technical, but also the popular reader. When purchasing an arc dynamo the purchaser usually asks for a 2000 or a 1200 c. p. outfit, and without giving the matter a moment's thought, concludes that a "nominal" 2000 c. p. lamp will give actually 2000 c. p. If he were to devote to the subject as much thought as he gives to the purchase of a hand lamp for his kitchen—to use oil—it would probably occur to him that just as the amount of light given to his coal oil lamp depends on the quality of the oil, the size of the wick, and whether the wick is turned up or down, so the light given by an arc lamp depends not merely on the current, but also on the quality of carbons, their size, and the distance between their points. As a matter of fact, any one can prove for himself that one can get more light from a 5 ampere lamp than from a 10 ampere one, by simply varying the size, quality and distance of the carbons. An arc lamp is nothing more or less than a mechanism for keeping two carbon rods always a little distance apart, and the lamp itself has no more to do with the light than has the bulb of the hand lamp that holds the oil, or the screw that raises the wick. So that if a purchaser desires to buy arc lamps properly, he should not ask for one of a particular candle power, but for one adapted for the use of a certain current to maintain the carbon rods a certain distance apart, and with a certain drop of potential across its terminals. The candle power is then entirely his own affair, and if he wishes to be very severe in his requirements he will then need to specify that with such a lamp as above, and using carbons of such and such a particular make, the candle power observed at such and such a distance from the crater, and at a specified angle from the horizontal plane passing through the crater, must be what he considers he wants. With a specification such as this he is equipped and is in a position to talk to manufacturers, but to consider himself badly treated and deceived because a lamp bought as a supposed 2000 c. p. does not give it with any kind and size of carbon, and at any distance from the ground, is just about as business-like as to buy a heating stove without saying whether it is to burn wood or coal. As

a matter of fact it has been over and over again proved that a nominal 2000 candle power lamp does not give more than 800 c. p. in the most intense direction with ordinary carbons, etc. If the electrical operating industry would take a hold of its interests a little better and would dictate its requirements it would be better for both operators and manufacturers.

SAMPLES OF SCALE AND FEED WATER WANTED.

Mr. Wm. Thompson has in course of preparation for this journal a series of articles on "Corrosive and Scale Forming Agents in Boiler Feed Waters." To make these articles of special value to our readers, Mr. Thompson wishes to receive from responsible steam users in all parts of the Dominion samples of scale and feed water. It is Mr. Thompson's intention to make complete analysis of the various samples, using them as practical illustrations of the formation of scale through various sources. These samples should be addressed to Mr. Thompson at Montreal West, Que.

ELECTRICAL TRANSMISSION OF POWER THE SUBJECT OF ARBITRATION.

PORT Arthur has been the scene of a most interesting arbitration case, which terminated on the 24th of November, after lasting two weeks. The case in dispute was as to whether one of the contestants should be permitted to divert the waters of the Kaministiquia river, at the head of a rapid on land owned by him, and carry it by means of a canal across not only his own land, but also across that owned by the other party, discharging the water at the foot of a fall 120 feet high which is situate on the land owned by the second party. The question left for the arbitration to decide was as to whether there was, at all seasons of the year, a sufficient quantity of water in the river to allow of the proper supplying of all the power that could at present, and in the near future, be consumed in Port Arthur and Fort William, using the 30 foot "head" that existed on the first contestant's property, or whether the natural flow of the river was liable to go so low that the above amount of power could not be generated except by utilizing the whole head between the top of the rapids and the foot of the fall—amounting to about 180 feet.

In order to properly appreciate the bearing of the mass of technical evidence given on both sides, and which will be of both interest and value to our readers as throwing light on the subject of the electrical transmission of water power, it will be necessary to explain that at a point distant some twenty miles from the towns of Fort William and Port Arthur, situate at the head of Lake Superior, the Kaministiquia river forms the Ecarte rapids, falling about 60 feet in one mile, and then precipitates itself over the Kakabeka Falls into a gorge 120 feet below their crest. In Fort William are four huge C. P. R. elevators, besides repair shops and other power consuming industries, and Port Arthur has one large cleaning elevator. In order to use the power of the Kakabeka Falls it will have to be electrically transmitted over the intervening 20 miles, and it will thus be evident that hydraulic and electrical engineering of a very high class will have to be employed.

The matters to be decided by either observation or argument were: The actual quantity of water in the river at the time of the arbitration, and whether that quantity was likely to be the minimum or not; the amount of power that that quantity of water would enable to be actually laid down in consumers' premises in the towns 20 miles away; and the actual and prospective market for power in the towns and elsewhere. The engineers engaged in preparation of reports and in giving expert testimony were: For Mr. Jenison, who was endeavoring to get the right to use the whole head of 180 feet, Mr. White-Fraser, of Toronto; and for the Kakabeka Land and Power Co., who were striving to restrain Mr. Jenison from so using the whole head, Mr. H. Wilde, chief engineer of the Sault Ste. Marie Pulp Co., who had charge of a portion of the Canadian locks at the Soo; Mr. H. Von Schon, a distinguished United States hydraulic engineer; Mr. H. Rickey, Mr.

R. Hesketh and Mr. J. Armstrong, the last two of Toronto.

A most accurate gauging was made of the river, using current meters, and the probable low water was calculated on the basis of the whole drainage area of the river, taken in connection with the rainfall, precipitation, etc., and temperature reports of the government. Some deductions were made of great interest and value. It appeared that the Kaministiquia river has varied between low and high water from a flow of not more than 5,000 cubic feet per minute in about February, to about 56,000 cubic feet in October, and a vast and totally unmeasurable quantity in floods. But what will probably be of most interest to our electrical readers is the calculations on transmission losses, which showed how much water would be required at 30 and at 180 feet head in order to render available 1,000 horse power at a consumer's shafting 20 miles away. It first came out that the following efficiencies could be depended on for the apparatus mentioned below, in very large units and of first-class construction and design:

Wheels...	80 per cent.
Generators	97 " "
Step-up and down transformers.....	99 " " each.
Large motors.....	97 " "

Giving a total efficiency (leaving lines out of consideration) of nearly 74 per cent., that is, that of each theoretical 100 h. p. in the water, 74 h. p. could be used. The transmission line calculations were even more interesting, involving, as they did, the calculation of the losses of power due to the reactance of the circuit. On the basis of 1000 h. p. laid down in Fort William, 20 miles away, with various voltages and percentages of resistance drop, it was shown that with 15,000 volts—10% resistance drop—it required a loss of 126 h. p. in lines alone to transmit 1000 h. p., not considering the losses in the wheels, etc.

With the above given efficiencies, and using 10%, 15% and 20% line losses for resistance, and calculating therefrom the resultant reactance losses, it was shown that to lay down 1000 h. p. 20 miles away required the following actual expenditure of power which had to be furnished by the water:

To lay down 1,000 h.p. with 10% loss required	1,550 h.p. in water.
" " " " 15% " "	1,694 " "
" " " " 20% " "	1,882 " "

The value of using a high voltage is shown by comparing the result of using 10,000 volts instead of 15,000, as below:

Using 10,000 volts—	
To lay down 1,000 h.p. with 10% loss required	1,694 h.p.
" " " " 15% " "	1,806 " "
" " " " 20% " "	1,908 " "

Comparing the 15,000 volt table with the one given under for 20,000 volts, shows that in all transmissions there is an economical voltage.

Using 20,000 volts—	
To lay down 1,000 h.p. with 10% loss required	1,560 h.p.
" " " " 15% " "	1,617 " "

Calculations as to the cost of the circuits showed that to lay down 1000 h. p. the cost would be as follows:

Using 10,000 volts, with 10%, would cost	\$23,760.
" " " " 15% " "	15,850.
" " " " 20% " "	11,880.
Using 15,000 volts, with 10%, would cost	11,880.
" " " " 15% " "	7,920.
" " " " 20% " "	4,977.
Using 20,000 volts, with 10%, would cost	5,940.
" " " " 15% " "	4,977.

If power were very valuable, that is, if the stream were not very powerful, or if power could be sold at a very high figure, then it would be best to save as much as possible by using 10,000 volts and 10% drop, or 20,000 volts at 10%. But on the other hand, if power were plentiful and could not be sold at a very high price, then it would probably be best to save the cost of transmission by using the highest voltage possible. It is needless to suggest that every case should be weighed on its own merits. In this arbitration it is understood that the result is that Mr. Jenison has proved his point, and as he proposes to undertake the work very soon, a most interesting construction may be expected, involving the transmission of nearly 5,000 h. p. over the long distance of 20 miles.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

NOTE.—Secretaries of Associations are requested to forward matter for publication in this Department not later than the 28th of each month.

ELEVENTH ANNUAL BANQUET OF TORONTO NO. 1.

OVER one hundred persons assembled at the Richardson House, Toronto, on Thanksgiving eve, Nov. 24th, in response to the invitation of Toronto No. 1 to participate in the eleventh annual dinner of the association. The proceedings of the evening were presided over in an able and discreet manner by Mr. G. C. Mooring, president of the association, and near him sat Messrs. A. M. Wickens, the founder of the society; E. J. Phillip, executive president; A. E. Edkins, Registrar Ontario Association; John Fox, past president; T. Eversfield, vice-president; R. C. Pettigrew, Robert Mackie, George Mackie, and J. Hunter, of Hamilton association. Besides a large number of other engineers, there were present the following persons: Mayor Shaw; Prof. Galbraith, principal School of Practical Science; George Anderson, manager Royal Oil Company; John C. McLachlan and F. H. Leonard, of the Toronto Motor Company; James McLaughlin, traveller Samuel Rogers & Co.; John J. Main, Polson Iron Works Co.; John Bayne, city traveller Royal Oil Co.; Joseph Wright, Bennett & Wright Co.; James Milne, Weeks-Eldred Co.; James Sinclair, Eureka Mineral Wool Co.; W. P. Sutton, manufacturer Sutton's compound; Geo. W. Grant, of Geo. W. Grant & Co., oil merchants; Mr. Powers, Vacuum Oil Co.; Alex. Horwood, secretary Toronto Technical School; W. G. Blackgrove, traveller Wilson & Co., oil merchants; O. B. St. John, representing Marine Engineers' Association; C. B. Edler, Montreal; J. Litster, manager Pure Gold Mfg. Co. Shortly after nine o'clock the guests gathered around the tables, and for an hour the menu engaged the attention of all, and no evidence was lacking that it was fully appreciated. During this hour Mr. A. E. Harding furnished choice selections on the piano.

The president welcomed the guests to the eleventh annual dinner. He referred to the formation of the association some twelve years ago, when eleven engineers met in Mr. Wicken's house and took the first active steps. Since that time great progress had been made, and the association now extended from Montreal to Winnipeg. He hoped that before long it would be spread over the whole of Canada. He asked all to join in singing "God Save the Queen." Then followed the toast of "Canada, our Home," coupled with the name of Mr. Anderson, who had recently returned from Japan. Mr. Grant sang "The Maple Leaf." Mr. Anderson said he was sorry they had mentioned that he was an oil man, as they had the reputation of being a pretty slippery and greasy lot. Referring to his visit to Japan, he said he was received like a king, being tendered banquets and otherwise entertained. At Japanese banquets the bill of fare included chestnuts, bamboo, raw fish and molasses. He thought our prospects for trade in the east were very encouraging. We had a country to be proud of, with boundless resources. He was told that there was two hundred and fifty million pounds sterling in England ready to come to Canada for investment. Our trade in the east, he believed, would astonish the world within the next ten years. Our manufacturing industries compared favorably with those of other countries, and the government was doing its duty to assist manufacturers; but business men, if they wished to succeed, should take off their coats and work. That was the only way to get trade. By request Mr. Geo. W. Grant sang "The Land of the Maple," and was followed by a comic song by Mr. Harry Brown. Mayor Shaw arrived just in time to respond to the toast of "Toronto, our Home." He was proud of the progress Toronto had made, and hoped to have the honor of opening the new city buildings next year. Referring to the city's future, he said that while Toronto wanted factories, he believed a greater necessity was to make Toronto an attractive city, a statement to which exception was taken by several of the speakers following. Mr. James Fax here made the usual hit by a comic song, followed by a witty story as an encore.

Coupled with the toast of "The Manufactures" were the names of Messrs. J. Main, of the Polson Co., F. H. Leonard, of the Toronto Motor Co., and James McLaughlin, of Samuel Rogers & Co. After a song by Mr. Litster, Mr. Main was called upon. Speaking of the engine and boiler trade, he stated that his firm were experiencing a greater demand every day. That trade was improving was shown by the increased enquiries from all parts of the country for boilers and steam power. As to Mr. Anderson's remarks that we could capture eastern trade, he did not think we

could compete with the Chinese and Germans, who were paid low wages, unless by employing cheaper labor, of which he was not in favor. We could not manufacture boilers and compete with these countries. What was wanted was the development of our own resources—we wanted smelting furnaces and rolling mills to work up our own ore and nickle. He did not agree with the Mayor's remarks as to the necessity of beautifying the city. In his opinion it was manufactories that were wanted, and something should be done to bring them here. Mr. Main closed his remarks with one of his humorous stories, and was heartily applauded. Mr. Leonard followed. He agreed with Mr. Main that prospects were never better for manufacturers than at present. Referring to the electrical business, with which he was most familiar, he said the development within the last five years had been wonderful. A few years ago it was almost impossible to find a future for the business, but it had gradually grown, until it was now an important factor in the industrial field. When in Montreal recently he learned that the Dominion Cotton Mills Company had made a contract for 1,500 horse power in a single piece, taking the place of three large engines. This amount of power was delivered at their switchboard, and distributed from there as required. By this means manufacturers were enabled to save power by dispensing with shafting. Toronto was not blessed with great water powers such as were to be found in the vicinity of Montreal, yet it was a good manufacturing point owing to its central location. Even if we had to rely on steam power, he thought there was a great future for the city. He knew of instances where steam power was being supplied at seventeen, eighteen and twenty dollars per horse power per year, with coal at a higher price than in Toronto. There was one point in favor of the steam engine—it was a reliable prime mover and could be depended upon, while you could not always depend on water power. Mr. McLaughlin said that since 1887, with one exception, he had been present at every banquet of the Toronto Association. He compared the working men of to-day with those of the early days, when they could barely eke out an existence. Now, thanks to the inventor and the workshop, they were no longer subject to the tyrannical beck and call of their master. Their position was now almost equal to those who were their employers. He gave some figures of imports and exports, which showed that only during the last two years had our exports exceeded our imports. The tide had recently turned, and we were now on the eve of increasing prosperity.

Songs by Mr. Thomas Eversfield and Mr. W. G. Blackgrove followed. The latter sang "Out on the Deep," and for an encore "Rocked in the Cradle of the Deep." "Educational Interests" was placed in the hands of Prof. Galbraith and Mr. A. G. Horwood. The former said that technical education had grown and developed wonderfully within the last fifty years, and the great gulf between educated and uneducated men had to a large extent passed away. Such education was drawing men closer together and unifying them, and would also have an effect in solving political problems. Messrs. Grant and Fax here sang a duet which created much laughter, some of the verses of which were as follows:

I've just heard some news that will cause you to say

Oh, goodness gracious!

The engineers flourish and prosper to-day,

Goodness gracious!

Just ten years ago they were hoble-de-hoys,

And as a society just a few boys,

Now nothing on earth can shake their equipoise,

Goodness gracious!

Since then they've increased both in numbers and strength,

And spread over the land its entire width and length;

To judge from this gathering as it now appears,

We'll be over run in the next dozen years,

For if they keep on, we'll be all engineers.

To be at their gatherings is always a treat,

A jollier set very seldom you'll meet;

From president Wickens to Mooring to-day,

And men of their stamp there is none will gainsay,

They meet to do good, and have come to stay.

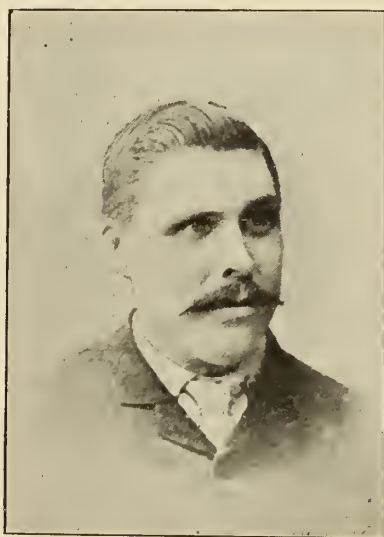
Mr. Horwood, in responding, referred to the good work of the Technical School. It was attended by a large number of engineers. At the last session of the Ontario House a bill was passed permitting towns to establish technical schools, and there was some doubt as to what effect this would have upon our high schools. Farmers would probably give their sons a scientific education. He was strongly in favor of shorter hours for workmen, and especially engineers.

Mr. E. J. Phillip responded to "The Executive." He said the association was growing gradually, and he hoped they would soon secure a compulsory license law, for which they were now working. In educational matters he believed the Hamilton association was doing the best work of any branch. Mr. Brown sang

"A Hot Time in the Old Town To-night," after which Mr. Wickens, the father of the order, was asked to respond to the toast of the "C.A.S.E." The association, Mr. Wickens said, was founded on principles different from any other society—it was founded on principles of self education, and was essentially and theoretically an educational institution. They could educate the employer as well as the engineer or fireman. The engineers felt they should have a license law. Marine engineers were compelled to pass an examination, and it was more important that stationary engineers, having charge in some cases of plants in factories where several hundred people were employed, should give proof of their competency. They got a permissive law for Ontario four years ago, and in that time 750 certificates had been granted to engineers. After getting this permissive law, the Toronto association commenced to agitate for a Technical School, and succeeded in securing a grant of \$2,000 from the government. That it was a success was shown by the attendance and the fact that the cost per pupil in the public schools was \$36.50 per year, while in the Technical School it was only \$6.60. The Toronto association had collected \$4,500; of this amount between \$70 and \$80 had been spent for assistance to members; \$440 for educational work; \$158 for legislative purposes; \$600 for property and library, and \$400 to the executive. They had assisted 200 members to secure situations, and employers were willing to pay higher wages for the services of members of the association.

The toast of "Sister Societies" followed a song by Mr. Grant. Messrs. Mackie and Pettigrew responded. They spoke of the relationship that existed between the Hamilton and Toronto associations, and of the good educational work that Hamilton No. 2 was doing. They had had some valuable papers, and others were arranged for. Mr. Mackie then proposed the toast of "Toronto No. 1," to which president Mooring replied briefly. The next toast was that of "The Press," which was acknowledged by Mr. Biggar, of the Canadian Engineer, and Mr. Young, of the ELECTRICAL NEWS AND STEAM ENGINEERING JOURNAL. After the health of the host had been drunk, the eleventh annual dinner became a thing of the past, amidst cheers for Toronto No. 1.

The banquet committee was composed of Messrs. Thomas Eversfield, chairman, Geo. Thompson, secretary, James Huggett, Samuel Thompson and C. Moseley.



MR. G. C. MOORING.

At Northamptonshire, England, in the year 1857, Mr. G. C. Mooring, president of Toronto No. 1, first saw the light of day. When a robust boy, 17 years afterwards, he removed with his parents to Canada, and found his first employment with Messrs. Thompson & Williams, engine builders, of Mitchell and Stratford, remaining with them for three years, during which time he obtained valuable experience in engine building and general machine work. Upon removing to Toronto he was employed by the Toronto Reaper and Mower Works for three years as machinist, and subsequently by the Massey Manufacturing Company. Then he accepted a position with the Toronto Bridge Company, now the Dominion Bridge Company, but after four years' service the works were removed to Lachine, and Mr. Mooring, choosing to remain in Toronto, assumed charge of the steam plant of the Standard Woolen Mills, remaining there four years. He then went to Brandon, Man., and put in a steam plant in Christie's saw mill, and while there assisted in forming the Brandon branch of the C.

A.S.E. Mr. Mooring returned to Toronto in 1889 to accept his present position with the Methodist Book and Publishing Company, where, besides having charge of the steam and electric plant, he has the entire mechanical superintendence of the establishment. He may be said to be an engineer by inheritance, his father, Mr. James Mooring, being a stationary engineer, and for twelve years has had charge of a steam plant in Toronto for Messrs. Langley & Burke.

Mr. Mooring has always taken an active interest in association work, and claims to have been greatly benefitted thereby. He was a charter member of the order, and the first secretary of the executive, and holds a first-class certificate from the Ontario association. In Toronto No. 1 he has passed through all subordinate offices to his present position.

MEETINGS OF TORONTO NO. 1.

At the regular meeting of Toronto No. 1, held on Wednesday, November 23rd, one new member was initiated. The receipts of the evening were \$110. Bro. Wickens read a paper on the "Indicator," which will be found in another column, and which resulted in an interesting discussion. At the meeting on the 1st inst., the Hall Board was granted permission to purchase a piano for the use of the association and tenants. The Banquet Committee reported, and it was stated that the Engineers' Hand-Book was ready to be turned over to the association. Commencing in January next, the second Tuesday in each month will be set apart for open meetings, to which steam users and engineers are invited. At 2 a.m. on the morning following the last meeting fire was discovered in the Engineers' Hall, 61 Victoria street, which destroyed their furniture, carpets, charter, etc., the damage being estimated at \$200. We are glad to learn that the library was only slightly damaged. It is thought the insurance will cover the loss.

HAMILTON NO. 2.

The Hamilton branch of the Stationary Engineers held an open meeting in their hall on Tuesday, Nov. 8th., president Wm. Norris in the chair. The meeting was well attended and very interesting. Instead of having a regular paper read, a number of questions taken from the question box were answered by some of the members. Pres. Norris explained the difference between an alternating dynamo and a constant current dynamo. He expected a paper going more thoroughly into the subject would be read later on in the season. He also made a few interesting and useful remarks on the construction and use of magnets. Mr. Geo. Mackie gave the formula, and explained the method of ascertaining the amount of horse power to be used by an engine in increasing or decreasing the number of revolutions per minute. He also satisfactorily answered a question on the supporting power of stays. At a later meeting a paper on "Measurement" was read by Mr. Ballard, which will be found elsewhere. The open meetings in connection with this association are very interesting and instructive, and are well attended.

KINGSTON NO. 10.

At the last meeting of the Kingston association an interesting paper was read, which provoked considerable discussion. A number of questions were found in the question box, and these were answered to the satisfaction of all.

DOMINION LICENSE LAW WANTED.

At a meeting held in Engineers' Hall, Toronto, on Nov. 23rd., to consider the question of securing legislation for engineers at the coming session of the Dominion Parliament, it was unanimously resolved that such a measure be introduced, and that all engineers and steam users possible for the committee to reach be communicated with, and their co-operation solicited. President F. G. Mitchell, 276 Talbot st., London, and Registrar A. M. Wickes, 280 Berkeley st., Toronto, will be pleased to furnish all enquirers with data and matter to work upon. A committee was appointed to draft a circular setting out the facts and necessities of the case, which the Registrar will have for distribution in a few days. The committee have had enquiries from Nova Scotia in the east, and British Columbia in the west, regarding such a law, and feel that the movement will be in keeping with the rapid advancement of the affairs of the Dominion at large.

The Ottawa Car Company are building a number of open cars for the new electric railway at Sherbrooke, Que. The company have about completed an extra long double truck vestibule car for the electric line running between Grimsby and Hamilton.

THE INDICATOR.*

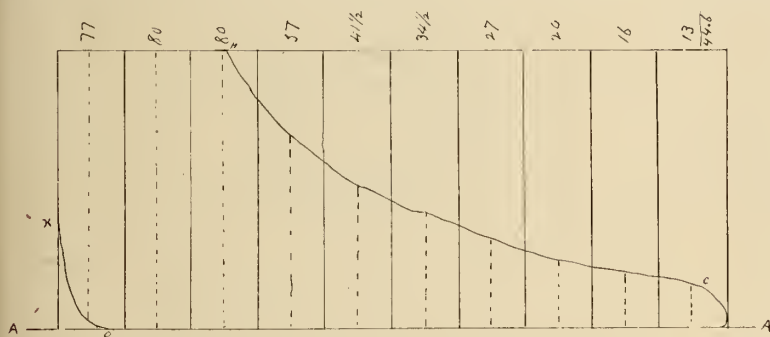
BY A. M. WICKENS.

At our last talk about the indicator we went into the matter of explaining the different motions to show the necessity of having the instrument carefully handled and connected with the cylinder for the pressure, and with some of the reciprocating parts of the engine to represent exactly the motion of the piston upon the revolving drum. It is imperative that the instrument shall be in perfect order, to insure accuracy. One means of testing this is to remove the spring and see that the piston will drop freely to the bottom of the cylinder when released from any point of its travel. You can make a further test by putting the spring in place and the indicator upon the connecting pipes, with a paper on the drum. Now push the piston down to the bottom of the cylinder, and release the pressure slowly, and when the pressure is all removed, draw the atmospheric line. Again pull the piston as far up as you can and again let it return to its normal position slowly, and draw the atmospheric line. If it is exactly upon the first line you may be sure it is correct at that point, and you may take it for granted that it will be correct at all other points of its travel.

The marking or pencil point should be fine and smooth, and if a metallic point is used, it should not be too sharp, thus avoiding cutting the paper. Do not allow the paper drum to run all the time, but stop it as soon as the diagram is taken. This can be done either by unhooking the driving cord, or by the stop motion with which many of the indicators are supplied.

You must be careful in the selection of the spring used; usually each indicator has instructions with it as to the different spring to use for different pressures. It may be taken as a general rule that the spring should be marked at one-half the initial pressure. It is best to use as light a spring as the pressure will allow, thus making the card as large as possible, for the larger the card the greater the defects will be shown. You must also exercise great care to get the drum motion to exactly represent the piston movement. This is difficult to do in high-speed engines. The best test is the length of the card; if it is longer when taken at full speed than when taken at the slowest speed the engine can be run at, then there is something wrong, and you will not get a correct card.

After having blown out the pipes with steam, put on the indicator and attach your cord, adjusting its length so that your card is exactly in the centre of your paper. Now unhook your cord and put on your paper, being sure that it is even at the corners and tight around the drum. You are now ready to take your card. Start up your drum by hooking on your card. Now turn on the steam by opening the cock at the bottom of the indicator;



leave this cock open a few seconds that the instrument may be warmed up, then shut off the steam and draw the atmospheric line; then open the cock and apply the pencil to the drum by pushing it towards the paper and holding it firmly against the stop on the instrument just sufficient time for the engine to make one revolution. You will then have a clean, fine-lined card—the only correct card to measure up the power of the engine from.

Having taken the diagram with our indicator correctly adjusted, and the connection properly made, we now want to know what is the h.p. as shown by the diagram. To find this it is merely necessary to measure the space enclosed by the diagram, and by this means get the mean effective pressure exerted upon the piston throughout its stroke, which this area really represents. This pressure being multiplied by the number of square inches of the piston area gives us the total pounds of force exerted, and as this force is acting through the distance travelled by the piston, we multiply it by the number of feet travelled per minute, and the

product is the number of foot pounds exerted in one minute. This divided by 33,000 is the h.p. of the card.

Having our indicator in perfect order and applying it, as described, to an automatic cut-off engine with the piston tight, and valves well set and tight, we should get such a card as shown, provided the load was such as to give us a cut-off about $\frac{1}{4}$ stroke. You now want to get the h.p. of this card, and to do this you only need to get the area of the space enclosed by the diagram, and as it is of rather a peculiar shape, we go about it in this manner: We erect a set of ordinates, or lines, at right angles, or perpendicular to the base line or the atmospheric line upon the card. Any number of these ordinates will do, and for convenience we usually put up 11 lines, making 10 equal spaces; the smaller the divisions the greater the accuracy. We now take a scale suitable to the spring used in the indicator, that is, a scale with each inch upon it divided into as many equal parts as the spring is intended for; this you will know by a mark upon the base of the spring, such as 16, meaning 16 pounds to the inch, or 40, meaning 40 lbs. to the inch. In this case we used a 40 spring, and consequently we take the 40 scale and proceed to measure the height of the diagram one-half way between each ordinate, or upon the dotted lines of the diagram. The height of the diagram at the first point of measurement is $\frac{3}{10}$ less than 2 inches, and represents 77 lbs.; the next is exactly 2 inches, representing 80 lbs.; 3 inches, 80 lbs.; 4 inches, 57 lbs.; 5 inches, 41 $\frac{1}{2}$ lbs.; 6 inches, 34 $\frac{1}{2}$ lbs.; 7 inches, 27 lbs.; 8 inches, 20 lbs.; 9 inches, 16 lbs.; 10 inches, 13 lbs., making a total of 446.

Now, as we have measured 10 spaces, we add them up and divide by 10; this gives us 44.6 lbs., and is the mean effective pressure (M.E.P.) throughout the stroke. This measurement has simply reduced our peculiar-shaped area enclosed by the diagram to a parallelogram the length of the card and of a height equal to 44.6, or $1\frac{4}{10}$ inches high. We know that the work done by the steam is the same as though the pressure was 44 $\frac{6}{10}$ lbs. from start to finish of the stroke. Assuming that our piston has an area of 100 square inches, and that it travels at the rate of 500 feet per minute, we can very readily arrive at the horse power represented by the card. 100 square inches $\times$ 44.6 lbs. = 4460 lbs.; this, you may say, is 4460 lbs. moments of work. Now, as our piston is travelling 500 feet per minute, we multiply the moments of work by the feet travelled per minute, 4460 $\times$ 500 = 2,230,000; these are the foot pounds of work, and the foot pounds divided by 33,000 is the horse power of the card, $\frac{2,230,000}{33,000} = 67.57$ h.p.

This is the total power exerted by the engine, including its own friction. Should you want to figure the water consumption from the diagram, it would be necessary to know the clearance of the engine—that is, the space between the piston and the valves—when the engine is on dead centre, and erect an ordinate at each end of the card, far enough away to represent the percentage of the clearance to the total piston displacement; but for simply measuring the h.p., or finding the M.E.P., this knowledge is not necessary. You will see at the lower left hand corner a curve marked G. & K.; this is the compression curve and represents that the exhaust valve closed at the point G., or about 3 inches before the stroke was completed. Our engine during this travel was compressing any small amount of air still remaining in the cylinder, and by the time the piston reached the end of the stroke the pressure reached the point K, or a pressure of about 28 lbs. This occurred before the steam valve opened to admit steam to move the piston in the opposite direction. Compression is useful for several reasons—one is that it decreases the knock when the motion of piston across head is reversed by gradually taking up any slack there may be, and another is that it fills the clearance spaces with steam compressed up to nearer the boiler pressure, and starts to re-heat the surface of piston and cylinder walls. If you should have a back pressure your diagram would show the atmospheric line, marked A, to be lower than the diagram, and it can be measured by the scale the same as the pressure, and should be deducted from the h.p. of the card.

A new 75 horse power boiler has been placed in the electric light station at Digby, N.S.

The Fern Mine, Hall Siding, in the Rossland district, B.C., are lighting up the mill and yards, as well as the tunnel of the mine, by electricity, and have placed the order for machinery and apparatus with the Royal Electric Co.

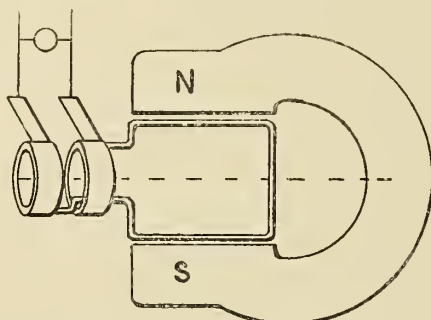
* Paper read before Toronto Association C.A.S.E., Nov. 17th, 1897.

DIRECT AND ALTERNATING CURRENTS.*

By F. H. LEONARD.

You are all aware that direct or continuous currents are so called from the quality which they possess of maintaining a uniformity of direction of flow with regard to the conductor through which they are passing. Direct currents, however, are not always of constant pressure; but are often intermittent or pulsatory in their character, and under such conditions exhibit many of the characteristics of alternating currents, which are constantly fluctuating with more or less rapidity from a positive value to the opposite or negative value many times in a second, the frequency of commercial alternators varying from 25 to 140 complete periods or cycles per second.

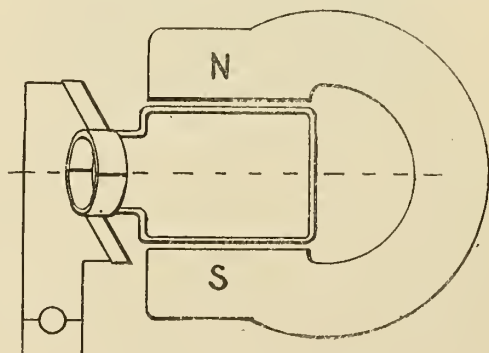
I shall not attempt in the short space of time you have to listen to me to-night to skim over the whole field, but will confine my remarks more particularly to the kind of electric currents the steam engineer is more apt to come in contact with. The rapid strides that electricity is taking makes it important that all should familiarize themselves with the laws governing this subtle force. Most any of you are liable to be placed in a position where you will have charge of one or more dynamos for generating electric



ALTERNATING CURRENT DYNAMO.

current for lighting or power purposes, and it is to dynamo electric current that I shall more particularly refer to-night. I assume that you are aware that metallic substances are good conductors, copper being the best commercially; also that most other substances are poor conductors, some being such poor conductors as to be termed insulators, such as glass, porcelain, dry wood, paper and cloth. The great Faraday, who may well be called the father of the electric dynamo, discovered in 1831 that when a coil of wire was made to approach a magnet, an electric current was momentarily established in the coil, as indicated by the deflection of a galvanometer connected in circuit with the coil. This discovery was followed by a series of experiments probably unequalled in any branch of scientific research for brilliancy of perception and clearness of reasoning power. This philosopher, before his death, gave to the world the fundamental principles upon which the dynamos of to-day are constructed.

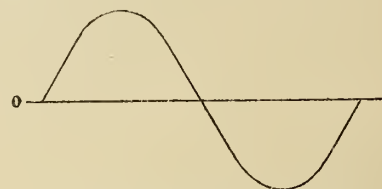
Starting with Faraday's principle of induction, let us construct a very simple form of dynamo. Take an ordinary horse-shoe magnet, and for simplicity I will show a single turn of wire arranged to revolve in the magnetic field; if to the two ends of this coil of wire we attach a pair of rings, and on them place two



SINGLE COIL DIRECT DYNAMO.

strips of thin sheet copper for brushes to conduct the current to the outside circuit, we have all that is essential for our dynamo. If in the circuit of this elementary dynamo we place a galvanometer—which is an instrument for indicating the flow of electric currents—we shall find that as we turn the coil about there will be a deflection of the pointer of our instrument, first in one direction, then in the opposite, as the coil in our dynamo assumes first

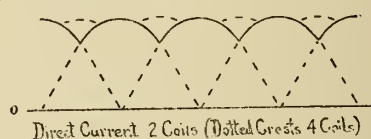
one, then the other position with regard to the magnet. We have produced then an alternating current. If we wish to obtain direct currents, we must change our construction, and substitute in place of our two rings a commutator, which in its simplest form consists of two sections. We will split a piece of tube in two, and mount it on the spindle in place of the rings, connecting one end of our wire to one part, the other end to the other part, insulating the two parts from each other, so there will be no electrical connection between them. Again we rotate the coil, and we shall find the galvanometer deflection takes place always in the same



Alternating EMF Sine Curve.



Direct Current Single Coil E.M.F. Curve.

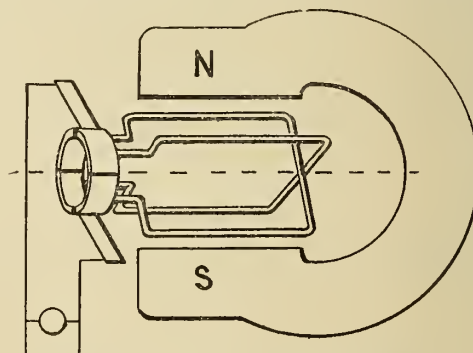


Direct Current 2 Coils (Dotted Crests 4 Coils)

direction, but comes to zero at each half revolution of the coil. We can represent by a curve just what takes place in the coils or armatures of these two forms of dynamos during the period of one complete revolution. Just as the steam engine indicator represents the pressure at every part of the stroke, so our curve will show the electro-motive force at every point of the revolution.

The E.M.F. (electro-motive force) curve of our alternating dynamo, starting from a line of zero potential, will rise more or less abruptly, depending upon the design of the dynamo to a point of maximum positive potential, then droop, and passing the neutral or zero potential line, descends to the point of maximum negative potential.

The most desirable form of all-round work, and the one which most modern, well-designed alternators follow, is the sign curve, though many single phase alternators, which are perfectly satis-



TWO COIL DIRECT CURRENT DYNAMO.

factory for lighting purposes, depart considerably from this form and show a peak-topped, and some a flat-topped curve. The E.M.F. curve of our direct current dynamo differs from the alternator for the reason that the commutator replacing the collector rings slips from under one brush to a position under the opposite brush, just at the moment the current in the coil is about to reverse, and instead of descending below the zero line, it again ascends, making in a complete revolution two curves, similar to the first half of our alternating current curve, both of which are above the zero line. Such a curve represents a series of impulses following each other with every half revolution, and would not make a satisfactory current for practical working. Other evils would also creep in, as we multiplied the number of turns to obtain the commercial voltages, which would produce vicious and destructive sparking at the commutator.

To obtain a commercial dynamo for direct currents we must then alter our design, and instead of using a large number of turns of wire in a single coil, we must divide these turns into a number of smaller coils, and furnish segments in our commutator to correspond with the increase in number of coils. We will first

* Paper read before Toronto No. 1, Canadian Association of Stationary Engineers.

see the effect of two coils spaced equally around the periphery of our armature with a segment attached to each end of the coils.

Now, if we trace an electro-motive force curve from this armature, we shall find that the pressure does not fluctuate so much as with the former arrangement, and instead of dropping to zero at each half revolution, the pressure is always maintained at a point of considerable pressure, for the reason that soon after a coil has passed into a position in the field where the rate of cutting lines of force is less, the commutator sections corresponding to this coil have slipped from under the brushes, and the sections connected to the other coil have passed under and into contact with the brushes, and supplies the circuit with a fresh E.M.F. rising in potential; the other coil in the meantime is out of circuit or idle. If, instead of two coils we employ a still larger number, we continue the process of smoothing out till we finally get a practically constant pressure throughout the revolution. Also, as we multiply the coils we shall find it desirable to avail ourselves of the E.M.F. generated in the coils, which are not in a position of maximum potential, and utilize the potential of coils rising to maximum and descending to zero; this will also materially reduce the sparking at the commutator. Thus, all the coils in a commercial dynamo are connected together and loops taken to the segments of the commutator, except in a few cases, notably the Brush arc dynamo.

So far the dynamos we have been considering have been constructed without iron in the armatures, but as iron is a much better conductor of the magnetic lines of force, which are depended upon to induce the E.M.F. in our coils, it would evidently be better to introduce an iron core into the structure, thus reducing the reluctance of the magnetic circuit. Also, we have used a permanent horse-shoe magnet, whereas we can obtain a much more dense and powerful magnetic field by using an electro magnet, which may be obtained by passing the electric current through a coil of wire surrounding an iron core. The shorter and thicker we can make the magnetic circuit, the less energy there will be required to produce the magnetic field, and wide air spaces are to be avoided, as they offer serious resistance to the flow of lines of force through the magnetic circuit. Part of the electric current generated by the dynamo itself is generally utilized to excite the field of direct current dynamos, though alternators are usually separately excited by a smaller direct current dynamo. What applies to the magnetic circuit in a direct current dynamo is equally true in regard to an alternating current dynamo. Care must, of course, be taken to insulate the copper of the electric circuit from the metal which is used for the magnetic circuit, as well as to insulate the various turns or convolution of the electric circuit from each other, so as to avoid short circuits.

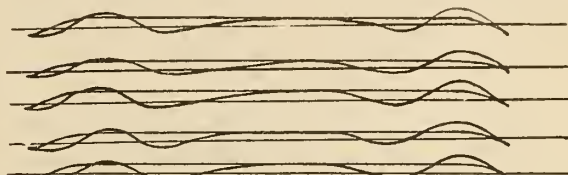
From what has been said, I trust you have been able to form a fair idea of the manner of obtaining both alternating and direct currents by means of the dynamo electric machine, which is only a piece of apparatus for transforming the mechanical energy of the water-wheel or steam engine into electrical energy. There are several types of direct current machines, but they can be divided into two principal classes—constant current dynamos and constant potential dynamos. The constant current dynamo is used principally for arc lighting, the flow of the current remaining fixed while the E.M.F. increases as the arc lamps or other devices are added in series. The constant potential dynamo is the type generally used for incandescent lighting and power purposes. This type of dynamo is designed to maintain a constant E.M.F. or pressure, and the current is increased as lamps or motors are added to the circuit in multiple. Alternators are also built for constant current and constant potential, though the former are not much used at present.

Direct currents are generally used at low E.M.F., 110 to 125 volts being common for lighting plants, though in arc dynamos the pressure in the larger sizes reaches as high as 8,000 volts. At 110 to 125 volts, of course, large conductors would be necessary to supply any considerable amount of energy, which necessarily confines this type of dynamo to limited areas, so the work can be reached without too large an expenditure for copper conductors. The alternating currents, however, on account of the facility with which they can be transformed from a high to a low voltage, or vice versa, without the necessity of any moving parts in the transformers or converters, as such devices are called, are generally used for transmitting energy to greater distances, and for distribution covering areas of many miles. The Niagara power is transmitted 26 miles to Buffalo by alternating currents generated by 5,000 h. p. two phase alternators at 2,000 volts, transformed to three phase alternating currents at 10,000 volts for the transmission, and at Buffalo transformed from 10,000 to about 340 volts alternating, which is then transformed by rotary transformers into direct current at about 550 volts for supplying the street railway motors. As can be seen from this instance, the flexibility of the alternating current system is wonderful, particularly when it is understood that these transformations take place in the static transformers with a loss of less than 2 per cent. for each change, the greatest loss for any change being in the rotary transformer, and even this is obtained at an expense of about 5 per cent. Under the high pressure alternating currents are transmitted with allowable loss and transformed to the lower and safer pressures on the spot where the current is to be utilized. It is difficult in so short a space to give much of an idea of either direct or alternating currents, not to mention their differences, but I have tried to touch on a few points, which I hope will awaken sufficient interest to bring about a deeper study of the subject.

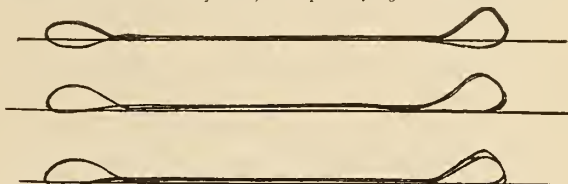
QUESTIONS AND ANSWERS.

In the October issue of the NEWS, "Indicator" stated that he was thinking of putting an indicator on his engine, an Armington & Sims, with 12 inch stroke, and asked to be given the sizes for the correct rigging, and instructions as to how to set it up. In reply thereto, a correspondent sends the following, accompanied by a number of cards, some of which we reproduce:

SIR,—In answer to "Indicator," although only an amateur at this work, yet I think my rigging correct. It is as follows: First, a plate $2\frac{1}{2}'' \times 2\frac{1}{2}'' \times \frac{1}{2}''$, with a slot in centre 2" deep $\times \frac{1}{2}''$, is screwed on to crosshead, then a standard screwed on to crosshead guide

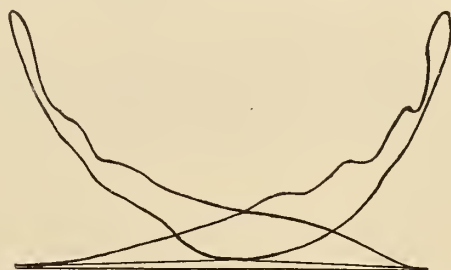


Exhaust Card.—Engine $9\frac{1}{2}'' \times 12$ in., 80 lbs. steam, 10 lbs. spring, 289 rev.; No. 10 dynamo, 60 amp. load, 113 volts.

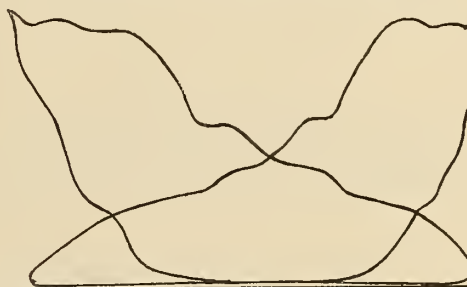


Exhaust Card.—Engine, $9\frac{1}{2}'' \times 12$ in., 80 lbs. steam, 10 lbs. spring, 285 rev.; 185 amp. load, 113 volts.

either by a hollow bolt or the oil cup itself. The lever is supported from this standard by a pin and held in place by a nut. At the bottom end of the lever there is a $\frac{1}{2}''$ pin to work in the slot in cross-head plate, with the pin a little long so that it will have no tendency to come out of slot. My lever is $20'' \times \frac{3}{4}'' \times \frac{3}{16}''$, and from centre to centre of pins is 18" long, equals 12 times the length of stroke. My cord is attached to a pin $4\frac{1}{2}''$ from top pin; instead of a cord, which I found stretched, I use a fine wire. At the end of cross-head guide I have a standard, with leading pulley attached, so as to take off my cord equal on both ends of stroke. If I am wrong at any point, I will be glad if those who know better will show the fault. The accompanying cards were taken by this rigging, and I would like to have a discussion on them. I make no remarks on them myself, as I cannot fully read them all, but perhaps some of your readers will be willing to take the trouble to do so. The exhaust cards were taken off the $9\frac{1}{2}'' \times 12''$ engine by a connection at the drain pipes through to the exhaust about 12" below cylinder. I inserted into the exhaust a piece of $\frac{1}{2}''$ pipe 3" long, the top half of pipe cut off so that it formed a channel



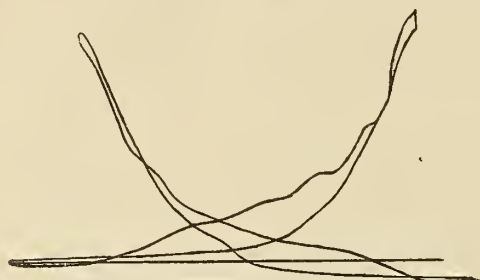
Centre T Connection.—Engine, $9\frac{1}{2}'' \times 12$ in., 80 lbs. steam, 40 lbs. spring, 292 rev.; No. 10 dynamo, no load.



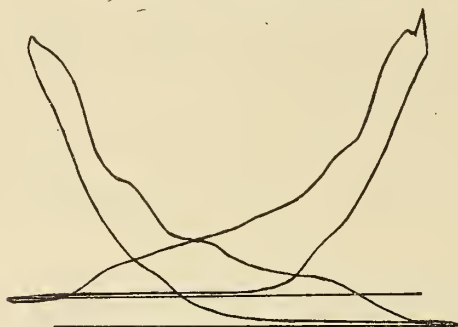
Centre T Connection.—Engine $9\frac{1}{2}'' \times 12$ in., 80 lbs. steam, 40 lbs. spring, 285 rev.; 185 amp. load, 113 volts.

for the steam to flow to the indicator. That it formed no back pressure can be seen by the cards off the cylinder, which were taken after I inserted this exhaust pipe. From the exhaust to indicator, pipe was 18" long. My cord from reducing lever was led over the leading pulley as for other cards. To let out any water, I put a cock on right at indicator, so that nothing lay there to distort card. The cord I used then stretched a little, so they are about $\frac{1}{8}''$ too long. The direct connection cards were taken when there was only indicator cock and couple and nipple between cylinder and indicator. I had, of course, to change indicator to each end each time, but as I had a steady load it did not matter. I moved the paper purposely on the barrel each time. In each case the head end is at the left hand side and the crank end at right. The centre T connection was arranged with a globe valve at each end and indicator in centre. I could have sent more cards of this, but those sent will show how much out

this arrangement was. The 12" x 12" engine is also an Armington & Sims, but had had considerable tinkering at it before we got it. The crank-pin runs almost hot nearly all the time, and we dare not key it up as it ought to be, and as a consequence she pounds the whole time. We have had the expert man of our village at it, and men from three different shops of our neighbor-

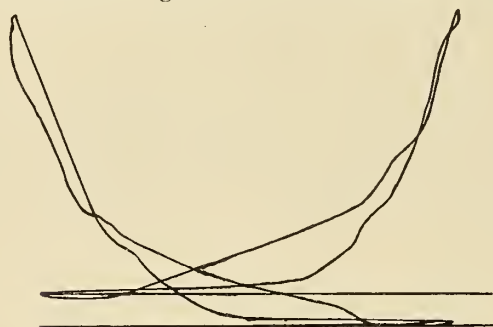


Straight Connection.—Engine 9½ x 12 in., 80 lbs. steam, 40 lbs. spring, 292 rev.; No. 10 dynamo, no load.

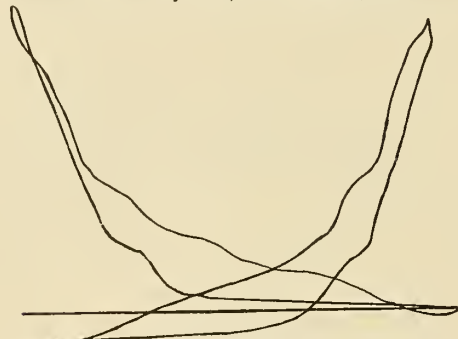


Straight Connection.—Engine 9½ x 12 in., 80 lbs. steam, 40 lbs. spring, 289 rev.; No. 10 dynamo, 85 amp. load, 110 volts.

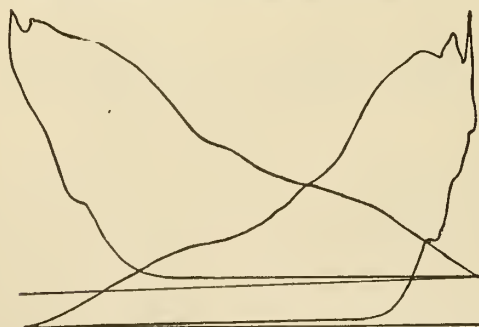
ing town, but nothing could be done, and thus it has been for two years. These cards I have taken just for my own enlightenment, and I trust they show up the trouble. Do they? The cards I would like most to be figured out are the exhaust, straight con-



Direct Connection.—Engine 12 x 12 in., 80 lbs. steam, 40 lbs. spring, 262 rev.; 2 No. 10 dynamos, friction load only.



Direct Connection.—Engine 12 x 12 in., 80 lbs. steam, 40 lbs. spring, 263 rev.; 2 No. 10 dynamos, 50 amp. load, 113 volts.



Direct Connection.—Engine 12 x 12 in., 75 to 80 lbs. steam, 40 lbs. spring, 55 rev.; 2 No. 10 dynamos, 320 amp. load, 113 volts.

nection and direct connection. Of course, if any one would go into more of them, I think it would be generally appreciated. Would there be any advantage in carrying a higher or lower pressure for the different loads?

"AMATEUR."

MR. Wm. Thompson sends the following answers in reply to questions asked in our November number:

"Ontario": Point of cut-off will vary in direct proportion to the load within reasonable limits. Under ordinary conditions, your engine at 80 lbs. gauge pressure, with a load of 25,000 watts, will have a ratio of expansion of about 4. It is not economy, in a single cylinder of this type, to expand more than 4 times. When load is reduced down to 6,250 watts, cut-off must take place considerably earlier in the stroke, with a corresponding increase in number of expansions. While engine is running underloaded, it would be economy to reduce steam pressure as suggested, so that point of cut-off will be about ¼-stroke. This, however, can only be carried out within reasonable limits, and much depends on style and condition of engine. "Ontario" must bear in mind that the same degree of efficiency cannot be obtained while running "underloaded" in comparison with "normal" load.

"Subscriber": Chimneys are required for a two-fold purpose, 1st, to carry off obnoxious gases; 2nd, to create draft. The first requires area, the second height. The intensity of the draft varies in direct proportion with the difference between external and internal temperatures, and any reduction in the temperature of the internal gases, with the temperature of external air remaining constant, directly affects the intensity of the draft. I would refer "Subscriber" to the report of a test made on the boilers of the Armour Packing Company at Kansas, to determine the saving effected by the use of "Green's Economizers," and published in Power for July or August last. In this report "Subscriber" will observe very clearly that as temperature of flue gases decreased readings of draft gauge also decreased, as well as combustion of fuel per square foot of grate surface per hour. The fact that "Green's Economizers" can be used with natural draft is due to many causes, chiefly to two: 1st, draft previous to installation of economizer was sufficiently good; 2nd, use of economizer may effect a saving in fuel ranging from 1 to 50 per cent., and required combustion of fuel per square foot of grate surface per hour is correspondingly less. The life of pipes would depend upon four things: 1st, quality of material and workmanship; 2nd, circulation and corrosive action of water on inner face of pipes; 3rd, depositing of scale forming materials from the water; 4th, action of corrosive acids generated from the fuel (such as sulphurous, sulphuric and nitric acids). A given quantity of heat is required to heat a given quantity of water to a given temperature. This is the same whether heat is applied by fuel or steam. I consider heating feed water with live steam a loss, and should only be used where no better method can be had, and then only because it prevents undue expansion and contraction of boiler plates and fittings due to cold water being pumped into the boiler.

"Subscriber" writes: I had been using two boilers, but the manager decided to operate one only, on the ground of economy. The small boiler is 5 x 13, and the large boiler now used 6 x 16, rated at 120 h.p. It is being forced to do the work of the two. The engine is 150 h.p., and there is a 1½-inch pipe running from boiler through the shop to dry lumber. Shavings are used for fuel. Do you think we are effecting a saving by using only one boiler?

ANSWER.—"Subscriber" does not say what power the 150 h.p. engine actually develops. If steam required for engine and drying purposes requires single boiler to be forced, there is certainly no economy in using only one boiler. Forcing a boiler past its capacity is extremely hazardous, and liable to lead to serious results. It is also a wasteful practice, as process of combustion cannot be carried out properly when fires have to be forced. If consumer could give quantity of water required to be evaporated hourly a very much clearer opinion could be offered.

"N.S." writes: Will you kindly let me know how storage batteries are charged. Can they be charged from an alternating current?

ANSWER.—Storage batteries cannot be charged by an alternating current; if, however, the current supplied by an alternating generator be rectified in any way, then it can be used to charge them. Storage batteries are charged by being connected across the mains of an ordinary direct current source of supply, like a lamp or other load, and left in circuit until the instruments used with them indicate that they are charged. Batteries are not apparatus that an inexperienced man should play with; they are rather expensive, delicate, and apt to get out of order if not very carefully charged and discharged. If properly cared for, they can, in certain conditions, be a valuable auxiliary to a plant.

Proposals for the construction of electric railways in the city of St. Petersburg are being considered. There will be eight miles of these tramways, with four central stations and a number of side stations. Fares will be about two cents first class and about one cent second class. The promoters of the railroads have asked for a concession for forty years, giving the city the option to purchase after twenty years.

At the present session of the Ontario Legislature the following companies will seek incorporation to build electric railways: Bothwell & Florence Electric Railway Company; Chatham City & Suburban Railway Company; Toronto and York Railway Company; Smith's Falls, Rideau & Southern Electric Railway Company; Seine River, Foby and Fort Frances Railway Company; and Sandwich, Windsor and Amherstburg Railway Company. The Hamilton and Dundas Street Railway Company, the Kingston, Portsmouth and Cataraqui Electric Railway Company, and the Toronto and Scarboro' Electric Railway, Light & Power Company will seek amendments to their charters.

WEBSTER SYSTEM OF STEAM HEATING.

REFERRING to the discussion on exhaust steam heating which has recently appeared in our "Questions and Answers" department, Messrs. Darling Brothers, Montreal, Canadian representatives of the Webster patent system of exhaust steam heating, write as follows:

"When the Webster system was first introduced in Canada and the United States, steamfitters would bid upon a gravity system and then add cost of the Webster system, resulting in a prohibitive figure for the work in most cases. After some experience they now estimate the cost of a gravity system and offer to install the Webster system at the same figure, and in some instances for less money. We offer the Webster system entirely on its merits and economies, claiming it well worth the price, when compared with systems offering no similar advantages. In fuel economies alone we have the most accurate data, taken from indicator cards, where the engineer was entirely impartial, showing that a back pressure of ten pounds on the engines caused a loss of fuel equal to 29%, and an efficiency equal to that percentage resulted from the application of the Webster system. The extent to which we can reduce pipe and valve sizes, the discarding of all forms of air valves, the less labor required, are incidental only, and permit the installation of the Webster system at a cost not exceeding a first-class gravity system."

PRESENTATION TO MR. JAMES MILNE.

FOR several years Mr. James Milne has been connected with the Terauley street electric light station in Toronto, formerly as superintendent for the Incandescent Light Company, and since its amalgamation with the Toronto Electric Light Company, as superintendent for the latter company. A few weeks ago it was announced that he had resolved to sever his connection with the company to assume the management of the Weeks-Eldred Company, general contractors and manufacturers of the Jones underfeed mechanical stoker. General regret was expressed among the employees, and as a token of their appreciation Mr. Milne was presented with an illuminated address, accompanied by a marble clock. Mr. Henry Amos, foreman of the meter department, made the presentation. The address, which was signed by over thirty employees, was as follows:

TO JAMES MILNE, ESQ.

DEAR SIR,—We, the employees of the Incandescent Electric Light Co., have learned with regret that you are about to leave us and sever your connection with the company. We take this opportunity to place on record our appreciation of your straightforward and manly treatment of us, and of your distinguished abilities displayed in the discharge of the duties of the office of superintendent of the company for the past five years. As a small mark of the esteem in which you are held by us, we beg to present you with this marble clock, and although its intrinsic value is not much, it will serve to keep us in remembrance.

We wish you complete success in your new position, and for Mrs. Milne, yourself and family, LONG LIFE AND PROSPERITY.

[Signed] HENRY AMOS J. G. GROUCHER
CHAS. MOSELEY WILLIAM GODDARD
ALEX. RUTHERFORD WM. PIKE, &c.

Mr. Milne replied in a happy speech, referring to the harmony that had always existed between the employees and himself. Mr. J. G. Croucher and others followed, emphasizing the kindly sentiments expressed concerning Mr. Milne in the formal address.

Mr. Milne takes to his new position ability of high order, coupled with a full stock of energy. When to these is added the advantage of a valuable training and experience in engineering, it will be apparent that in his present position he is likely to prove himself to be the right man in the right place.

INEFFICIENCY OF STEAM PUMPS.

TORONTO, Nov. 23, 1897.

To the Editor of the CANADIAN ELECTRICAL NEWS.

DEAR SIR,—No economy should be too small to receive the attention of a careful manager. I recently heard of one which I commend to all. Steam pumps for boiler feeding, I claim, are a very inefficient apparatus, and could be replaced by either power pumps operated off the shafting, or by others actuated by an electric motor. In either case the power consumed in the mere forcing of water against the boiler pressure would be a very inappreciable item, whereas if the quantity of steam consumed by a steam pump could be measured, it would be found quite considerable. It is seldom, if ever, required to pump while getting up steam, and indeed it might always be arranged to pump the boiler full after shutting down; the actual annual saving in coal consumed would be found to considerably more than pay interest on the cost of the apparatus, whether a power or steam pump were used.

I would be pleased to learn the views of others interested in the subject.

Yours truly,

"ENGINEER."

TRADE NOTES.

The Royal Electric Co. is shipping the Hamilton Electric Light & Power Co. one of their single phase 2000 light alternators, with station apparatus, etc.

The W. A. Johnson Electric Company, Toronto, have removed from York street to 134 King street west, where they have more commodious and convenient offices and warerooms. This company are representatives of the celebrated Wagner transformers.

Roberval, Que., is to have an electric light plant. Mr. B. A. Scott, who has the matter in charge, has placed an order for the Crocker special turbines with the Jenckes Machine Co., of Sherbrooke, Que., to be delivered in ten days.

The Canadian Cotton Mills, of Milltown, N.B., have closed a contract with the Royal Electric Co. for one of their 30 k.w. "S.K.C." two phase dynamos, wound to deliver 110 volts to the service mains. Within the last eight weeks this is the third large manufacturing establishment to install one of these machines of the Royal Electric Co.'s make, the Penman Mfg. Co., of Paris, and the Cockshutt Plow Co., of Brantford, being the other two.

Mr. J. H. Walker, who for many years was manager of the Canadian Rubber Company's Toronto branch, has recently severed his connection with the company and established a wholesale agency for rubber goods at No. 88 Bay street, Toronto. Mr. Walker's long and valuable experience in handling this line of goods, coupled with his personal qualifications, will doubtless enable him to make satisfactory business connections and win success in his new venture.

We are advised by the Packard Electric Co., of St. Catharines, Ont., that they have recently imported from England a sand blast frosting machine, which will enable them to produce frosted lamps superior to those which have been previously placed upon the market. The fine frosting produced by this machine absorbs much less of the light than an ordinary frosted lamp. This company are also in a position to do any style of fancy frosting, bringing out letters, monograms and any desired design upon lamps to be used for decorative purposes.

PUBLICATIONS.

"The Elementary Principles of Machine Design" is a valuable little book by J. G. A. Meyer, and published by the Industrial Publishing Company, New York. It treats of the subject in a clear and concise manner, and is well illustrated.

The Power Publishing Company, New York, have favored us with a copy of a very useful and comprehensive book, entitled "Power Catechism." It contains what are claimed to be correct answers to numerous questions covering the main principles of steam engineering and the transmission of power, and should be of special assistance in preparing students for examinations. Profusely illustrated, carefully prepared and neatly printed, a volume of considerable merit is presented.

EDUCATIONAL DEPARTMENT

INTRODUCTORY

After mature deliberation the publisher of this journal has decided to devote a certain amount of space each month to what may be termed an Educational Department, wherein both mechanical and electrical formula and mathematical problems will be discussed, illustrated, and as far as possible rule and example given. At the request of the editor, I have with pleasure undertaken to contribute to this department regularly each month, and before discussing actual mathematical problems, wish to briefly introduce the subject at issue.

The primary object of this department is chiefly to increase the value of an already valuable paper, by placing in the hands of every engineer who has any knowledge of the rudimentary principles of mathematics, such matter as will enable him by a little study to master the most intricate mechanical and electrical formula. Many of our most valuable engineering works and publications from time to time contain formula that is in many cases but vaguely understood, and very often entirely misunderstood, thus rendering an otherwise valuable work practically valueless to the reader.

Just at what particular point our calculations should commence became a matter of serious thought, and past experience had to be carefully considered, bearing in mind the fact that there are many really good engineers whose early education has, through force of circumstances, been deficient, and many others who, through lack of opportunity, have not been able to review their early education for years. Knowing by observation and experience the great necessity of having a thorough elementary education before attempting to digest and calculate problems, and the almost utter impossibility of the student arriving at a satisfactory conclusion of his studies without a thorough knowledge of the principle of mathematics involved, I have decided to commence at a point and carry out the programme outlined in this journal—commencing at the foundation and advancing by easy stages until the principles underlying the most obtuse and difficult formula can be readily explained and easily understood. The advantages to be derived from an education of this kind, coupled with practical mechanical ability, is too well understood to require comment.

The programme which has been outlined for the succeeding nine months will embrace:

DECIMAL FRACTIONS—Definitions and explanation of principles of, and method of reduction to common fractions, and vice versa.

SQUARE AND CIRCULAR MEASURE—Definition and explanation and practical demonstrations of.

CUBICAL AND CYLINDRICAL MEASUREMENTS—Definitions and explanations of, with practical hints.

SQUARE AND CUBE ROOT—Definitions and explanations of.

SAFETY VALVE CALCULATIONS—(Spring and Lever Types)—Principles of, with practical demonstrations.

BOILER CONSTRUCTION—Stays, rivets, joints and seams, iron and steel plate—strength of, with formula and practical demonstrations.

It is not the intention to fill these columns with a mass of figures hastily compiled without reference to any particular object; on the contrary, every problem will be carefully thought out, and only such information given as will be of use to you, and an effort will be made, based on experience and a knowledge of the requirements, to make his series of tests complete in every particular.

WM. THOMPSON.

[ARTICLE VIII.]

APPLICATION OF OHM'S LAW.

(Continued.)

IN our last article we dealt with the application of Ohm's law to what may be termed single conductor circuits, where the source of electrical energy may be either a battery or a dynamo, as the case may require. In this article we will briefly illustrate by example the application of Ohm's law to portions of circuits, and also to divided or shunt circuits.

PORTIONS OF CIRCUITS.

All portions of a single circuit must of necessity receive the same current, but the electromotive force, or what is usually styled difference of potential, or drop in potential, and resistance, may vary to any extent in different sections of the circuit.

Example (4): A generator maintains a constant E M F of 110 volts between its terminals. The terminals are connected to and current is passed through a series of four coils, one having a resistance of 50 ohms, one 25 ohms, one 12.5 ohms, and one 6.25. Paying no attention to the resistance of the conductors between these coils, what is the E M F between the terminals of each coil?

A solution of this problem can best be reached by application of principle laid down in rule 3, viz.: That the electromotive force varies directly with the resistance and with the current.

In this case we wish to find E M F at given points on the line, when R alone of coil is known. The total R of the four coils is 93.75 ohms; calling the coils 1, 2, 3, and 4, and the difference of potential at their terminals E^1 , E^2 , E^3 , E^4 , we get the proportion.

$$\begin{array}{rcl} \text{As} & 50 & E^1 \\ 93.75 : 25 & :: 110 \text{ volts} : E^2 \\ & 12.5 & E^3 \\ & 6.25 & E^4 \end{array}$$

Then working out the problem by regular rules of proportion, we get

$$\begin{array}{l} \text{E M F of } E^1 = 58.7 \text{ volts.} \\ \text{E M F of } E^2 = 29.3 \text{ " } \\ \text{E M F of } E^3 = 14.7 \text{ " } \\ \text{E M F of } E^4 = 7.3 \text{ " } \end{array}$$

An examination of the problem will also prove to the student the theory of the statement that all portions of a single circuit must receive the same current. Taking, for example, total resistance of line at 93.75 ohms, and E M F at terminals of generator at 110 volts, and applying rule No. 1, we get

$$C = \frac{E}{R} \text{ or } \frac{110}{93.75} = 1.17 \text{ amperes.}$$

Applying the same principles to the coils, E^1 , E^2 , E^3 and E^4 , we find that current at terminals of each is the same.

Example (5): Suppose the same external circuit was connected to a generator having a resistance of 10 ohms. The E M F of the 50 ohm coil has been found to be 60 volts, what is the E M F at the terminals of the generator, and what would be the E M F of the generator on open circuit.

The total R of our coils has been found to be 93.75 ohms, and by rule 3 we demonstrate that, as the resistance of the coil is to the total R of the circuit, so is the E M F at the terminals of the coil to the E M F at the terminals of the generator,

$$\text{Or,} \quad \text{as } 50 : 93.75 :: 60 : x, \\ \text{and } \therefore x = 112.5 \text{ E M F at terminals of generator.}$$

By following rule 1, we find the current at the terminals of coil No. 1 to be

$$\frac{60}{50} = 1.2 \text{ amperes.}$$

The total resistance of the circuit is the internal resistance of the generator = 10 ohms; the resistance of the conductors, of which no account has been taken, and the resistance of the four coils = 93.75 ohms.

$$10 + 93.75 = 103.75 \text{ ohms, total R of line.}$$

Then to find required E M F of generator to maintain a current of 1.2 amperes through a resistance of 103.75 ohms, we must apply rule 2.

$$E = R C,$$

$$\text{or } 1.2 \times 103.75 = 124.5 \text{ volts, required E M F of generator.}$$

STRENGTH OF BOILERS.

Having determined the strength of the boiler at the joints, we next require to determine safe working pressure, thickness of plate, tensile strength per sectional inch, etc.

A standard boiler is said to be 42 inches in diameter and have a safe working pressure of 100 pounds per square inch, if constructed in best manner of iron plate one-quarter inch thick, having a tensile strength of 48,000 pounds per sq. inch of section.

From this, then, we can construct the following formula to determine the safe working pressure of any boiler:

$$\frac{TS \times 2T \times \% \text{ strength of joint}}{D \times FS} = P,$$

and from this we require but a slight transposition to construct a formula to determine either the diameter or thickness of plate required to conform to this standard, and

$$\begin{array}{l} \frac{D \times P \times FS}{TS \times \%} = 2T \div 2 = T, \text{ and} \\ \frac{TS \times 2T \times \%}{P \times FS} = D. \end{array}$$

This formula refers to any boiler, no matter whether constructed of iron or steel, 48,000 pounds being taken as the tensile strength for iron, and 60,000 pounds being taken as the tensile strength for steel, and four being taken as a factor of safety in each case when boiler is constructed in best manner.

Example (1): Find the safe working pressure of an iron boiler, made in best manner, joints having a sectional strength equivalent to 70% of solid plate; boiler being 42 inches in diameter and having plate $\frac{3}{8}$ of an inch thick.

$$\frac{TS \times 2T \times \%}{D \times FS} = P = \frac{48,000 \times .75 \times .70}{42 \times 4} = 150 \text{ pounds, safe working pressure.}$$

Same boiler in steel would become:

$$\frac{60,000 \times .75 \times .70}{42 \times 4} = 187.5 \text{ pounds per square inch safe working pressure for steel.}$$

Example (2): Find the required thickness of plate (steel) required in a boiler five feet in diameter, to carry a safe working pressure of 100 pounds to the square inch, sectional strength of a triple rivetted joint being 70% of strength of solid plate.

$$\begin{array}{l} \frac{D \times P \times FS}{TS \times \%} = 2T, \\ \frac{60'' \times 100 \times 4}{60,000 \times .70} = 2T = \end{array}$$

$$\frac{24,000}{42,000} = .571 \div 2 = .285 \text{ inches, or nearly } \frac{5}{16} \text{ inch, required thickness of plate.}$$

Example: What diameter should a boiler be when constructed of iron made in best manner and with $\frac{1}{2}$ inch plates, working

pressure to be 200 pounds per square inch, joints and rivet sections having a tensile strength equal to .70% of strength of solid plate,

$$\frac{T \times S \times 2T \times \%}{P \times FS} = D = \frac{48,000 \times 1. \times .70}{200 \times 4} = \frac{33,600}{800} = 42 \text{ inches.}$$

Same boiler constructed in steel:

$$\frac{60,000 \times 1. \times .70}{200 \times 4} = \frac{42,000}{800} = 52.5 \text{ inches.}$$

Example: Find the strain per sectional inch on a boiler 42 inches in diameter, having $\frac{1}{4}$ inch plate and having a working pressure of 100 pounds per square inch.

Formula:

$$TS = \frac{P \times D}{2T} = \frac{100 \times 42}{.5} = 8400 \text{ pounds strain per sectional inch of plate.}$$

STEEL FURNACES AND FLUES.

The Canada Steamboat Act provides that the external working pressure to be allowed on plane circular steel furnaces and flues when subjected to such pressure, when the longitudinal joints are welded or made with a butt strap, shall be determined by the following formula: $90,000 \times \text{the square of thickness of plate in inches} \div (\text{length in feet} + 1) \times \text{diameter in inches}$ equals the working pressure per square inch, provided it does not exceed that found by the following formula:

$$\frac{8,000 \times T''}{D''}$$

T'' thickness in inches.

D'' diameter in inches.

The length to be measured between the rings, if the furnace is made with rings.

Example: Find the working pressure of a circular flue 36 inches in diameter, 6 feet long and made of $\frac{3}{8}$ inch steel plate.

$$\frac{90,000 \times \frac{3}{8}^2}{(6+1) \times 36} = \frac{90,000 \times .1406}{7 \times 36} = \frac{12654}{252} = 50 \text{ pounds working pressure.}$$

$$\text{Check: } \frac{8,000 \times T''}{D''} = \frac{8,000 \times .375}{36} = 83.3 \text{ lbs.}$$

The collapsing pressure of a plane circular furnace tube is found by the following formula:

$$\frac{806,300 \times T^2}{D \cdot L} =$$

When T equals thickness of plate in inches.

D equals diameter of flue in inches.

L equals length of flue in feet.

Example: What is the collapsing pressure of a furnace tube whose diameter is 36 inches, length 6 feet and thickness of plate $\frac{3}{8}$ inch?

$$\frac{806,300 \times .1406}{36 \times 6} = \frac{113,365.78}{216} = 524.84.$$

CORRUGATED STEEL FURNACES AND FLUES.

Steel flue furnaces, when new, corrugated and machine made, and practically true circles, the working pressure is found by the following formula, provided that the plane parts at the ends do not exceed six inches in length, and the plates are not less than $\frac{1}{16}$ of an inch thick and furnace made in one length.

$$\frac{12,500 \times T''}{D''} = \text{working pressure.}$$

And for corrugated iron furnaces made similarly the following formula can be used:

$$\frac{10,000 \times T''}{D''} = \text{working pressure.}$$

Example: Find the working pressure allowable on a corrugated steel furnace flue 42 inches wide, 7 feet long and $\frac{3}{8}$ thickness of plate,

$$\frac{12,500 \times .375}{42} = 111.6 \text{ pounds.}$$

Find the working pressure allowable on same furnace constructed in iron.

$$\frac{10,000 \times .375}{42} = 89.3 \text{ pounds.}$$

The electric light company at Dartmouth, N. S., have offered to dispose of their plant to the town for \$30,000. By agreement they are bound to give the corporation the first right of purchase. The citizens' committee has reported that the plant is not suited to the requirements of the town, and it is probable that arrangements will be completed with a New York company, represented by C. K. Corsaut, to purchase the plant. This company have in view the development of the water power at Fall River, at an expenditure of \$100,000.

PERSONAL.

Mr. J. B. Kelly, of Blyth, Ont., has accepted the position of manager of the Goderich electric light plant.

Mr. Chas. W. Hagar, formerly manager of the Royal Electric Company, Montreal, has been appointed manager of the Dominion Burglary & Guarantee Company.

Mr. J. F. Richardson, chief electrician of the Canadian Pacific Railway, has just returned from the Yukon, where he surveyed the route for a telegraph line over Chilcoat Pass.

Mr. Shirley Davidson, of Montreal, has accepted a position as electrical engineer in Jamaica. Mr. Davidson was captain of McGill University football team, and is an all-round athlete.

We regret to learn that Mr. F. S. Barnard, manager of the British Columbia Electric Railway Company, is suffering from a broken leg, the result of being thrown from his buggy.

Mr. Peter Patterson, superintendent of the National Tube Works Co., McKeesport, Pa., was recently promoted to the position of consulting engineer. Mr. A. M. Saunders has been appointed superintendent.

Mr. W. L. Bird, of Bracebridge, Ont., at present taking the course in electrical engineering at the Canadian General Electric Company's works in Peterboro', has accepted a position with the Lachine Rapids Hydraulic & Land Co.

Mr. F. B. Brothers, superintendent of construction on the Montreal Street Railway, left a fortnight ago for Jamaica, in connection with the proposed electric railway at Kingston. Mr. Brothers expects to return to Montreal in a short time.

LEGAL DECISIONS.

A CASE of considerable interest was heard at Stratford, Ont., last month, being an action for damages brought by Cyrus Hacking against H. P. Dwight, president of the G.N.W. Telegraph Company. Hacking, who was an operator employed by Messrs. Gladwin & Donaldson, brokers, of Buffalo, wrote the latter firm, who had leased a wire in Western Ontario from the Great Northwestern Telegraph Company, intimating that they were being overcharged by the G.N.W. Telegraph Company. The letter was shown to President Dwight, who wrote Gladwin & Donaldson to the effect that Hacking's epistle was "a piece of gratuitous impertinence," and that Hacking "was on the black list for some time and was likely to remain there." Hacking complained that Dwight's letter was libellous and claimed damages. The jury returned a verdict for Mr. Dwight, asserting that there was no libel.

The American Society of Mechanical Engineers met in New York this month, and from the number and value of the papers presented the proceedings must have been of more than usual interest. Mr. F. R. Hutton, 12 West Thirty-first street, New York, is secretary of the society.

The annual statement of the Cornwall Street Railway Company, recently issued, showed a total year's business of \$25,282.68, made up as follows: Passenger receipts, \$16,557.35; freight, \$1,661.47; other sources, \$7,063.80. The operating expenses were \$20,172.81, the items being salaries, repairs, fuel, snow sweeping, insurance and sundries. The bond interest was \$2,500, and the account interests \$1,250, leaving a net profit of \$1,359.87. The capital stock of the company is \$150,000, and it has in the treasury \$33,800.



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ELECTRIC RAILWAY DEPARTMENT.

ELECTRIC RAILWAY DEVELOPMENT.

AN exchange gives some interesting figures relative to the development of electric railways in the United States :

Ten years ago there were only 86 miles of electric railway track in the United States. Now there are over 14,000 miles. In these ten years street railway propulsion has been revolutionized. Horse cars have disappeared entirely from most of the lines and will soon be curiosities, cable lines have probably reached their maximum mileage, while the number of electrically operated cars has grown from 172 to 37,000. These are some of the impressive facts shown by the following table, taken from an article in the *Western Electrician*, entitled "A Decade of Electric Railway Development:"

	January 1 1888	1897
Total number of operating street railway companies in the United States.....	615	806
Number of street railway systems operated by horses.....	566	167
Number of street railway systems operated by cable.....	18	38
Number of street railway systems operated by steam dummies (not including elevated).....	35	33
Number of street railway systems operated by electricity.....	21	698
Mileage of horse car track.....	5,474	1,010
Mileage of cable track.....	217	515
Mileage of steam dummy track, (not including elevated).....	216	145
Mileage of electric track.....	87	13,580
Total mileage of street car tracks.....	5,993	15,250
Number of horse cars.....	21,736	3,664
Number of cable cars.....	2,777	5,957
Number of steam dummies and cars.....	423	318
Number of electric cars.....	172	37,097

Total number of street cars, all descriptions... 25,108 47,036

In 1888 the horse car tracks represented over 91 per cent. of the total, and the electric railway tracks a little over 1 per cent. At the commencement of this year the horse car tracks were a little more than 6½ per cent. of the total, while electric railway tracks represented more than 89 per cent. and were still growing. It is important to note, however, that in these ten years of electrical development very little progress has been made in the direction of substituting electric motors for steam locomotives, excepting upon elevated roads.

C. J. Myles, A. J. Nelles, and Mr. Jennings, C.E., recently made a trip over the proposed extension of the Hamilton, Grimsby and Beamsville railway from Beamsville to St. Catharines.

The by-law to guarantee the sum of \$50,000 for the building of an electric railway in St. Thomas, Ont., was carried by the rate-payers on the 30th ultimo by a large majority. Under the agreement the company must build six and one-half miles of track. Mr. J. H. Still is the promoter of the scheme.

Messrs. B. F. Pearson, of Halifax, and Wm. Mackenzie, of Toronto, were in Montreal recently completing arrangements for the construction of the electric railway at Kingston, Jamaica, reference to which was made in the November number of the *NEWS*. The work of construction is to be pushed on rapidly during the winter months, so that by the next hot spell the inhabitants of the island may enjoy all the delights of rapid locomotion in hot weather, without the discomfort of personal exertion. Among those interested in the Jamaica syndicate are: H. M. Whitney, Boston, Mass.; F. S. Pearson, New York; Jas. Ross, Montreal; William McKenzie, Toronto; W. B. Ross, Q.C., Halifax; R. C. Brown, Halifax; B. F. Pearson, Halifax; R. D. McGibbon, Q. C., Montreal; Granville C. Cunningham and W. B. Chapman, Montreal.

THE LATE MR. ROSS MACKENZIE.

A TELEGRAM from Nelson, B. C., a few days ago, announced the death of Mr. Ross Mackenzie, a gentleman well-known to many readers of this journal. At the time of his death, which is supposed to have resulted from an injury received at Niagara Falls, and for which an operation was performed, he was employed officially by the C. P. R. in connection with the construction of the Crow's Nest Pass railway.

The late Mr. Mackenzie had for years been engaged in railway work. He was a son of Mr. Campbell Mackenzie, of Toronto, and was born in 1857 in the city of New York, but removed to Canada when quite young. In 1873 he entered the service of the Shedden Company in Toronto, and two years later was removed by the company to Hamilton. In 1878 he accepted the



THE LATE MR. ROSS MACKENZIE.

position of book-keeper for the Credit Valley railway, and in 1884, when this railway was merged in the Canadian Pacific railway, he became general superintendent's accountant of the Ontario division. Afterwards he was removed to Montreal, where he remained for several years. Shortly after the completion of the Niagara Falls Park and River Railway, the management thereof was offered to and accepted by Mr. Mackenzie. About one year ago he tendered his resignation, and quite recently accepted a position on the Crows' Nest Pass Railway. Mr. Mackenzie was a member of the Canadian Electrical Association, and served on the executive committee for one year while manager of the Niagara Falls road.

A few years ago Mr. Mackenzie stood in the front rank as an athlete. He was best known as a lacrosse player, being captain of the Toronto lacrosse club early in the eighties, and the holder of the world's record for throwing the ball.

The American Rattan Co. have just completed their new factory and are removing to the town of Walkerton. They have purchased from the Royal Electric Co., for lighting their factory, a complete electric lighting equipment.

SPARKS.

Brockville, Ont., is agitating for a municipal lighting plant.

An electric light plant is being installed at McAdam Junction, N.B.

Noble & Barber, electrical contractors, have started business in Montreal.

The town of Cobourg, Ont., are asking for permission to install an electric light plant.

The city council of Stratford, Ont., will advertise for tenders for the right to build a street railway.

Messrs. Smith & Co. have a contract for lighting the village of Gatineau Point, Ont., by electricity.

Late exports from New York City to Hamburg, in Germany, included large quantities of electrical supplies.

Elias Rogers has put in a dynamo for electric lighting and to operate the crane used in unloading coal vessels.

The Dodge Wood Split Pulley Company, of Toronto, recently received an order from an English firm for 3,900 pulleys.

The Knowlton Electric Light Company, Knowlton, Que., has been dissolved. Austin W. Peters is now sole proprietor.

The Montreal Street Railway Company have re-elected Mr. L. J. Forget president, and Mr. James Ross vice-president.

Two hundred and twenty installations of electric light are said to have been made in Buenos Ayres, Argentine, this year.

The Mayor of Hamilton has been interviewed by a gentleman who submitted a scheme for an electric railway from Hamilton to Caledonia.

Mr. H. J. Beemer is credited with a scheme to purchase the North Shore line of the C.P.R., and have the whole Quebec system electrified.

Mr. Morley Jarvis, of Guelph, and Mr. Page, of St. Marys, have invented an apparatus whereby exhaust steam can be used for different purposes.

The Deschenes Lighting Company have been asked to stretch wires across the river and supply electric light to the villages of Britannia and Birchton, Que.

Mr. St. Germain, of North Toronto, is said to be negotiating for the construction of horseless carriages, to run between York Mills and the C.P.R. crossing.

The Hull Electric Company has purchased the Aylmer branch of the C.P.R., which is at present under lease, the price being in the neighborhood of \$100,000.

The town council of Annapolis, N. S., have voted in favor of purchasing an electric light plant. The question will be submitted to a vote of the ratepayers.

The appeal of the London Street Railway Company against an assessment of \$80,000 on rails, poles and wires was argued a fortnight ago, and judgment reserved.

Swainson & Pierce have commenced business at Wallaceburg, Ont. They will handle electrical goods, such as medical batteries, door bells and burglar alarms.

The Ottawa Street Railway Company have experienced considerable trouble on account of motors being either absolutely destroyed or seriously damaged by water.

A scheme has been mooted to build an electric railway from Bobcaygeon to Peterboro, the cost being estimated at \$200,000. Provincial and Dominion aid will be asked for.

The Kingsville Electric Light & Power Co. have placed an order with the Royal Electric Co. for a 50 light 6½ amp. arc machine, with lamps, for lighting the streets of Kingsville.

Abraham Goodwin and John Kerr, Brantford, have bought out the repair department of the A. R. Williams Co.'s machinery agency there, and will operate it on their own account.

The Dominion Cotton Mills Company have given a contract to the Lachine Rapids Hydraulic & Land Company for the supply of electricity for power purposes for a period of twenty years.

Messrs. Moodie & Son, of Terrebonne, Que., have completed their new factory and are lighting the same throughout with electricity. The order for the electrical apparatus has been placed with the Royal Electric Co., Montreal.

Mr. Treffe Lavigne, foreman in the street railway power house at Ottawa, and who recently ran for alderman in Victoria Ward, is suffering from an electric shock. He was working on one of the machines when he made a short circuit. Immediately the

wires which he was holding became a mass of flame, and his hands got a severe scorching.

The Lachine Rapids Hydraulic & Land Company have made a proposition to the Harbor Commissioners to supply shipping interests with electric power for loading and unloading vessels. The chief engineer has been requested to report on the proposition.

The St. Jerome Electric Light Co., of St. Jerome, Que., have purchased from the Royal Electric Co., and are installing in that town, a 50 k.w. S.K.C. two-phase alternating current dynamo, with Stanley transformers, etc. They expect to start up with 750 lights installed.

An important innovation is being made on the Canadian portion of the Grand Trunk Railway system, in substituting compressed air for steam as a motive power in their shops. It is said to be cheaper than steam, and has been applied successfully in the shops at Toronto, Belleville and other places.

It is rumored that the Sherbrooke Street Railway Company will extend the line to Little Magog Lake next summer. It is also rumored that Messrs. R. N. Arkley & Son will construct a dam on the Magog, below the Little Lake, at a point on Mr. Henneker's estate, to develop supplementary power for the company.

The Folger-Hammond Mines Company has been organized in Toronto, Sir Richard Cartwright being president and Mr. W. H. Carvey secretary. They propose operating near the Saw Bell mine, in north-western Ontario. Tenders will be invited for the supply of electric power from Clearwater Falls, one mile distant.

The Department of Public Works at Ottawa has been advised of the completion of the extension of the government telegraph line along the north shore of the St. Lawrence, from Esquimaux Point to Agwanus, a distance of 80 miles. Offices have been opened for business at Agwanus, Piastro Bay and Sheldrake. The line is now 350 miles from Belle Isle.

The Windsor Electric Light & Power Co., of Windsor, N. S., whose plant was destroyed by the late fire, immediately started to rebuild the same, and have given an order to the Royal Electric Co. for apparatus and transformers, etc., consisting of S. K.C. alternators and Stanley transformers. The ashes of the old station had hardly grown cold before the order for the new apparatus was placed.

Referring to the proposed transmission plant at Goldstream, B.C., Mr. F. S. Barnard, manager of the British Columbia Electric Railway Company, writes as follows: "We have not yet definitely decided upon plans for a transmission plant. I may say, however, that our generating station will have a capacity of about 1,000 h.p., developed by water delivered under a 570 ft. effective head. This power will be transmitted by a voltage of about 10,000 to the sub-station at the city of Victoria, a distance of about twelve miles, and there distributed for the purpose of running our street cars, arc and incandescent light and power circuits.

The corporation of Fort William is about to erect a complete an electric lighting plant as, perhaps, is in use in any town in Canada. They are installing one 50-light 2,000 c.p. arc dynamo, with 35 double or all-night lamps for lighting the streets of the town and the C. P. R. yards, and for the incandescent service are installing an S.K.C. alternating current dynamo with a capacity of 1,000 lights, with Stanley transformers throughout. The corporation expects to be in a position to furnish light by the 1st of January next. The entire electrical equipment has been bought from the Royal Electric Co., and the engines and boilers from the Robb Engineering Co., of Amherst, N. S. The station which is now being erected is only temporary, and will likely be changed in the spring when the new waterworks system is installed.

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SPARKS.

The electric light plant at Drayton, Ont., owned by J. L. Pollock, was recently damaged by fire.

The motormen and conductors of the Ottawa Electric Railway have formed a fraternal organization.

The Rosamond Woolen Co. have ordered an \$8,000 boiler and engine from Goldie & McCulloch, of Galt.

Mr. J. E. Jones, of Kingston, Ont., has invented a street car fender, which is said to work very satisfactorily.

The Canadian General Electric Company have in course of construction at Peterboro', Ont., a new power and pump house.

The London Street Railway Company will probably return to the use of coal stoves. It is said that heating by electricity exhausts too much power.

At the Digby, N. S., electric light station recently, the attachment to the governor gave way and a smash-up followed. Engineers Daley and Armstrong received a slight shock.

The St. Jerome Power & Electric Light Company have had such success in canvassing for lights that they have changed their order from a 1,000-light S.K.C. machine to one of 1,500 lights capacity.

The Gravenhurst Electric Light & Power Company have purchased new arc lamps.

The Cascade Water Power and Light Company, composed of Rossland and Spokane capitalists, will build an electric railway in the vicinity of Grand Forks. It will also furnish electric light.

Mr. A. A. Dion, of the Ottawa Electric Company, is delivering a series of lectures on "Electricity" at the Canadian Institute. A large number of students are taking this course at the institute.

Charles R. Hosmer, of Montreal, general manager of the Canadian Pacific Telegraph service, the Postal-Pacific Telegraph Company, and the Commercial Cable Company, has lately returned from the west. He says that within the next year the Canadian government will construct and complete a telegraph line to Dawson City, and by the identical route originally surveyed 30 years ago by George Kennan, the Siberian traveller.

The United States consul at Creffield reports the discovery of what he terms incandescent gas. A single jet of ordinary size can emit light of much more than 1,000 candle power, and fine print can be read at a distance of 100 feet. The inventor says that the cost of a light of 1,500 candle power is only 4½ cents per hour, while that of an ordinary electric light of 400 candle power is 14 cents per hour.

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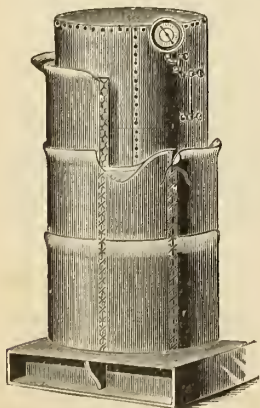
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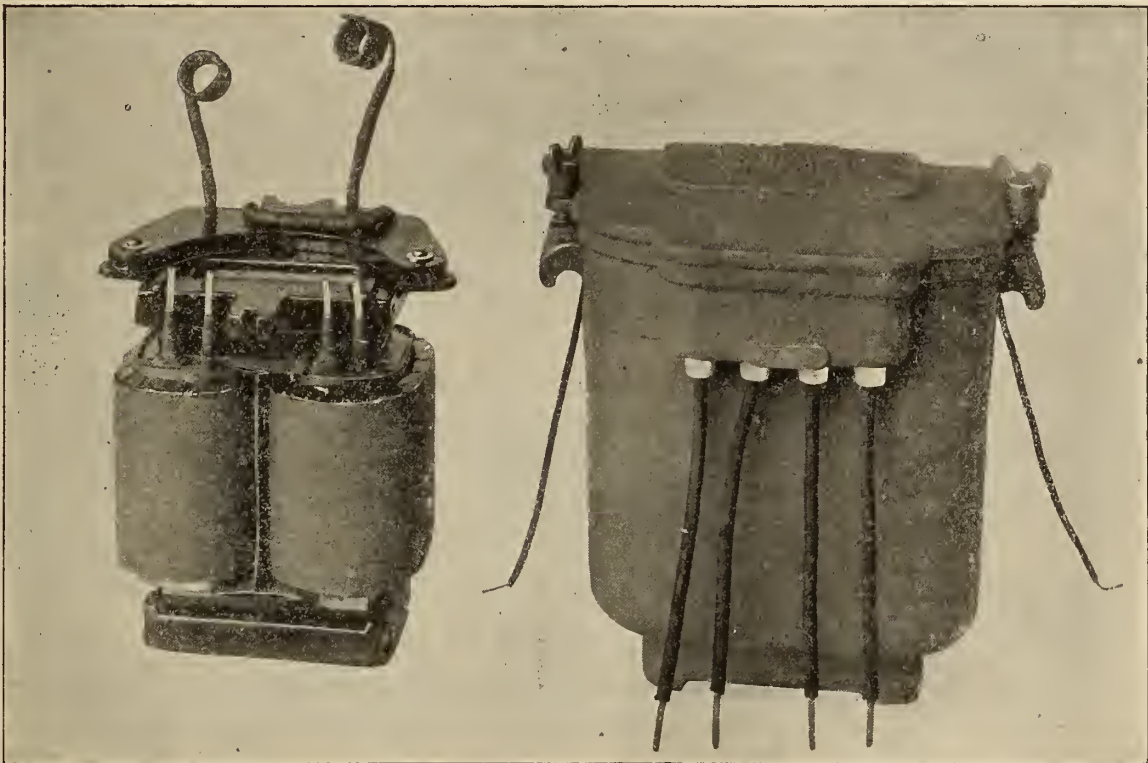
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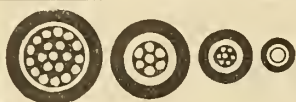
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The Governor-General has approved of the rules for the inspection of steamboats and for the examination of marine engineers.

It is rumored that the Atlantic and Lake Superior Railway Company, who own the Lachine and St. Andrew's railway in the province of Quebec, intend converting the road into an electric system and extending it to Carillon. The question of motive power has not yet been definitely decided upon.

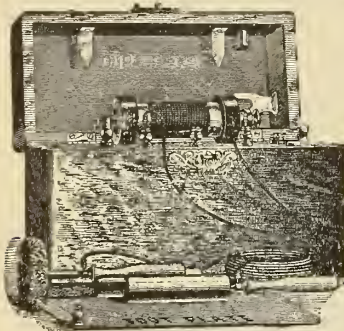
Some years ago a company was formed in Bridgetown, N. S., to light the town by electricity, but nothing was done. Now we are informed that the company have completed arrangements with the owners whereby they will acquire the right to lay pipes, construct dams and sluices, and build a complete waterway from Currel's Brook. In addition to lighting the town by electricity, they also propose to furnish power for commercial purposes.



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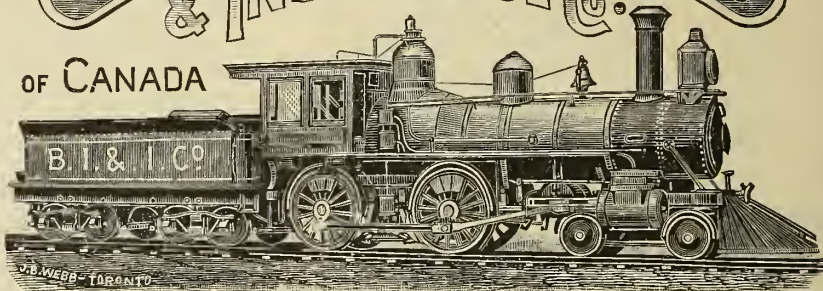
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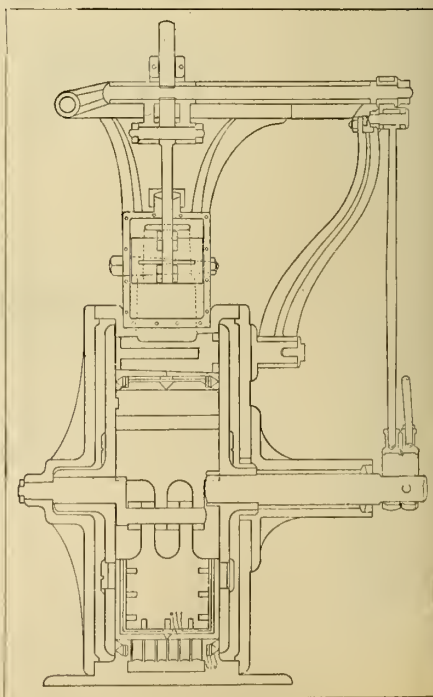
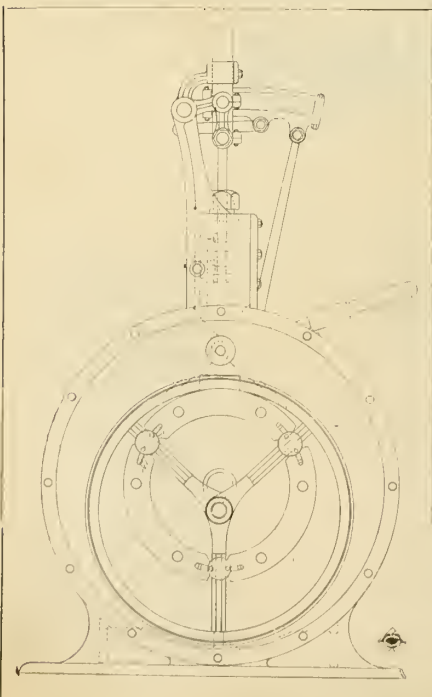
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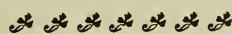
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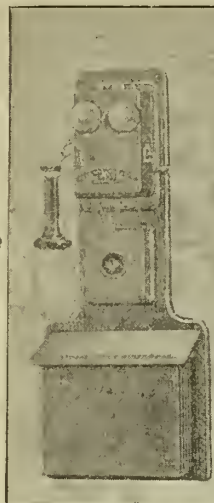
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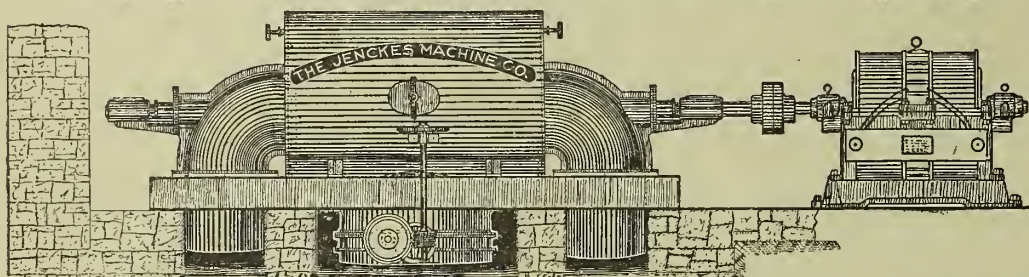
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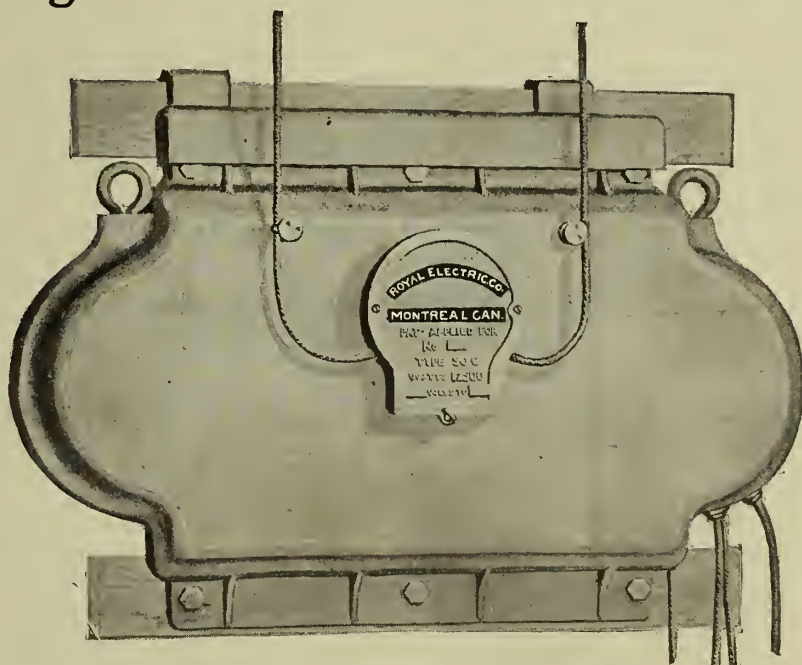
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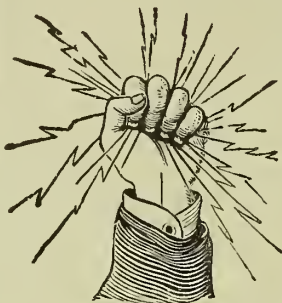
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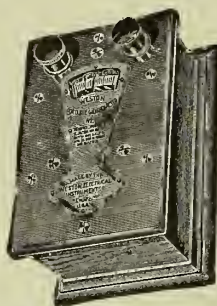
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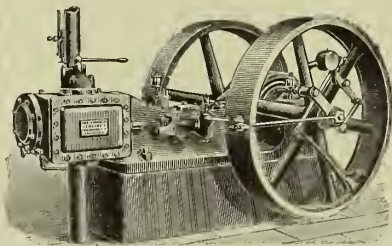
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CANADIAN

ELECTRICAL NEWS



—AND—

Steam Engineering Journal



VOL. VIII



1898 :

THE C. H. MORTIMER PUBLISHING COMPANY OF TORONTO, LIMITED,
TORONTO, CANADA.

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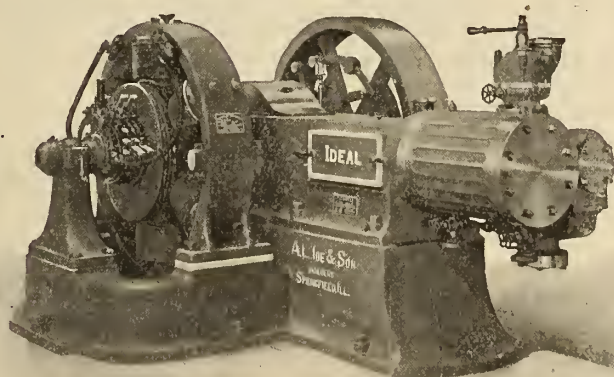
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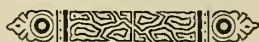
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CANADIAN
ELECTRICAL NEWS
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STEAM ENGINEERING JOURNAL.

VOL. VIII.

JANUARY, 1898

No. 1.

COMPLIMENTARY BANQUET TO MR. H. P. DWIGHT.

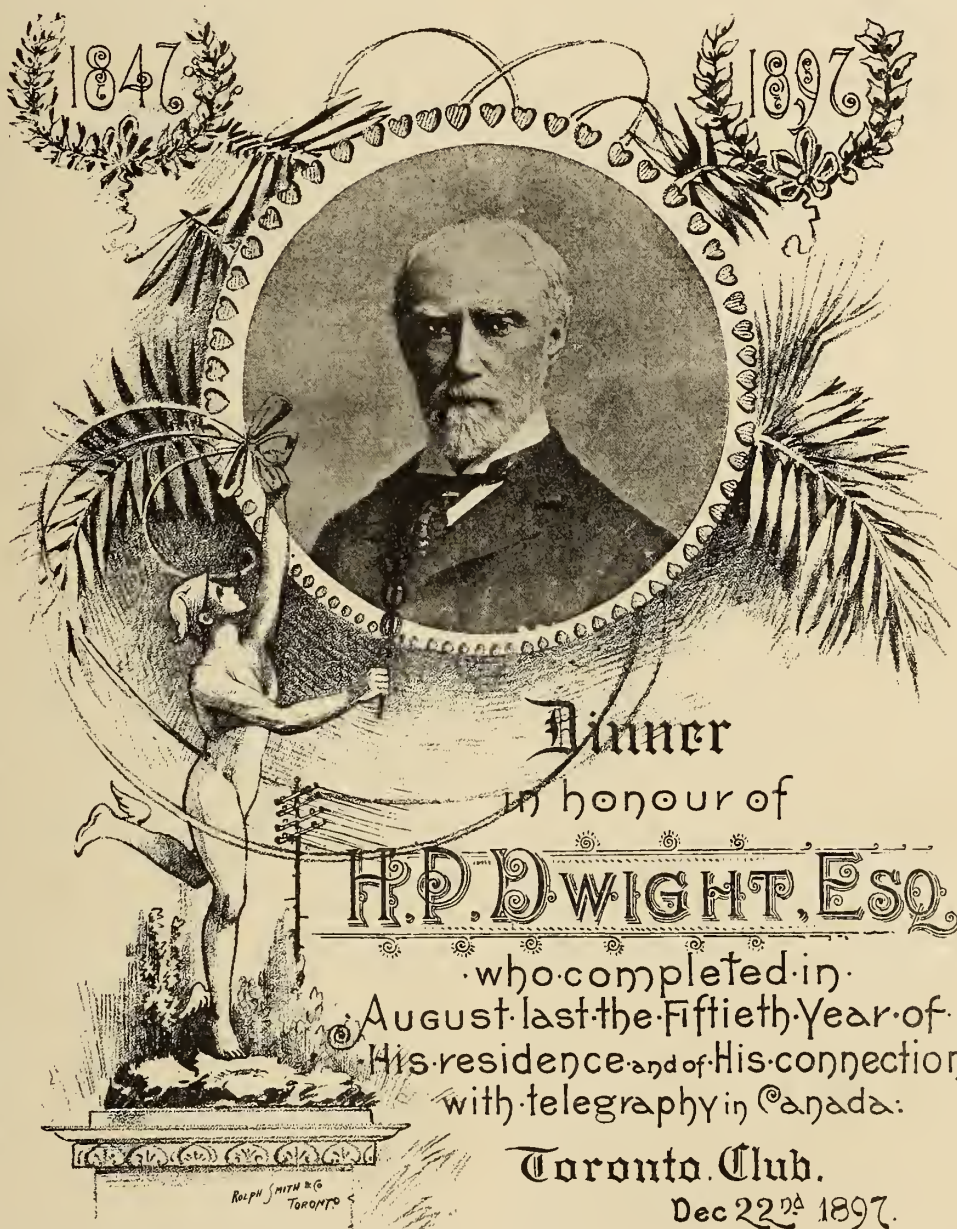
RARELY does it happen that a man spends fifty years in the service of one corporation, beginning at the bottom rung of the ladder and climbing to the top, without other assistance than natural ability and indomitable perseverance. Still less frequently is it that one occupying a semi-public position, manages to retain throughout so long a period the good will and high esteem of all his acquaintances and those with whom he is brought into business relations. Such, however, is the record achieved by Mr. H. P. Dwight, president and general manager of the Great North Western Telegraph Company, and veteran of the telegraph service in Canada. Notwithstanding the scriptural injunction "Beware when all men speak well of you," Mr. Dwight has

cause for the highest gratification in the fact that his conduct during more than half a century has been such as to call forth a spontaneous expression of public esteem such as the complimentary banquet tendered to him by his more intimate friends at the Toronto Club on the 22nd ultimo, and the praise and good wishes from all classes of the community in which he resides.

The banquet, which was presided over by the Hon.

G. A. Cox, was one of the most enjoyable and, in every particular, successful affairs of the kind ever held in the city. The character of the table decorations was calculated to remind the company that they had met to do honor not only to a gentleman of tried business ability and manly worth, but also to one who is an ardent sportsman. In the center of the large oval table was a miniature

lake in which fishes darted to and fro, and on the surface of which floated facsimiles, to a small scale, of the light birch bark canoe with which Mr. Dwight has become so intimately acquainted in connection with his yearly visits to the Muskoka and Nipissing districts for a quarter of a century past. The menu card, the front page of which is herewith reproduced, was also suggestive in this particular, one page showing an illustration of Dwight camp and its surroundings on Long Lake, Muskoka,



followed from this quotation from Rudyard Kipling:

"Who hath seen the beaver busied? Who hath watched the white tail mating?
Who hath lain alone to hear the wildgoose cry?
Who hath worked the chosen water where the ouananiche is waiting,
Or the sea trouts jumping crazy for the fly?
Do you know the blackened timber, do you know that racing stream?
With the raw right-angled log-jam at the end
And the bar of sun-warmed shingle where a man may bask and dream,
To the click of shod canoe-poles round the bend,
It is there that we are going with our rods and reels and traces
To a silent smoky Indian that we know;
To a couch of new pulled hemlock, with the starlight on our faces,
For the Red Gods call us out, and we must go."

The menu card, which was nicely lithographed in

two colors, also bore inscriptions such as the following :

"A sudden thought strikes me—Let us swear an eternal friendship."

"Man is the nobler growth our realms supply,
And souls are ripened in our northern sky."

The chairman eulogized the many admirable qualities of head and heart of which Mr. Dwight is the possessor, and was followed, in similar vein, by Mr. B. E. Walker, who concluded by proposing the toast to "The Guest of the Evening," at the same time placing in Mr. Dwight's hand a handsome album containing the photographs of all present, and an illuminated address which read as follows :—

DEAR MR. DWIGHT,—In August, 1847, you came to Canada to enter the service of which you have been for many years the chief executive officer. Of these fifty years of continuous residence in the country of your adoption, forty-seven have been spent in Toronto.

In the course of your long connection with the telegraph system of Canada you have seen it grow from small beginnings to its present large proportions, and it has been your fortune to aid, more than any other individual, in its great development.

While seeking to honor you for your persistent devotion and signal ability in enlarging the use and extent of this wonderful machinery for diffusing information, we desire more warmly still to honor that quality of unselfishness which, while you held no public office and sought no reward, has prompted you throughout a long life to do innumerable public and private acts of usefulness and kindness. Nor can we forget that there are many persons scattered over this continent, besides those gathered here, who have long admired your energy in a great and arduous work, your steadfastness in trying circumstances, and your consistent uprightness of character throughout.

We have, therefore, invited you to be present with us to-night, in order that this small section of your host of friends may drink with you the loving cup in commemoration of an eventful year in your life, and as a token of our personal affection.

Mr. Dwight replied with deep feeling, expressing his sincere appreciation of the honor conferred upon him, after which he read a very interesting sketch of his life, in which are embodied many reminiscences of the early history of telegraphy in Canada. He said :

I was brought up on a small, stumpy, stony farm of 25 acres, a few miles south of Oswego, where my father, with such assistance as I could render him, occupied his spare time in making flour barrels for the mills at that then small village at the mouth of the Oswego river. When about 18 years of age it dawned upon my mind very forcibly that I had better get away and find some way of making a better living for myself, and with better prospects if possible than I seemed likely to ever find at home. The erection of a telegraph line had just been completed between Oswego and Syracuse, and I made application and obtained permission to enter the Oswego office, in order to learn the business of an operator. I had heard about this time that a telegraph line was being built by the Montreal Telegraph Company in Canada, where I thought I might get employment. After ascertaining the name of the superintendent, Mr. O. S. Wood, I wrote to him applying for employment, and received a prompt reply, in which he asked me to report myself as soon as I was able to manage a small office, which in due course I did. I came over from Oswego to Kingston on the 27th of August, 1847, where I met Mr. Wood by appointment, and proceeded with him on the same day to Belleville, for the purpose of opening an office there, on the line which had been erected during that season between Quebec and Toronto, a distance of 500 miles, on which some 12 or 15 offices were being opened. Mr. Wood, I might mention, was the first pupil of Prof. Morse, the inventor of the Morse system of telegraphy, and one of his most intimate friends. We took instruments along with us, and opened the office in Belleville the following day, where I was left in charge, and where I performed the duties of both operator and messenger and remained for a couple of months. At the end of that time I was ordered to Montreal, to take my place in that office as an operator. In these early days, I may tell you, a telegraph operator was looked upon as of some importance, and the telegraph office as a decided curiosity.

EARLY ACQUAINTANCES.

During my stay in Belleville I became acquainted with Mr. John Ross, now Hon. John Ross, Mr. William Darling, and Mr. Mackenzie Bowell, the young editor of the Belleville Intelligencer, now Sir Mackenzie Bowell. A few months ago I received a letter from Sir Mackenzie in which he wrote as follows : 'Seeing your name reminds me of the time about 50 years ago when you were a telegraph operator in Belleville, when you one day read off from the instrument, while I copied down, the first telegraph news despatch ever sent over the wires, and which I printed in my little newspaper.'

I took my place as operator in the Montreal office, and remained there until the spring of 1850. While acting as operator I also acted occasionally as messenger, batteryman, line repairer, and, in fact, did everything more or less that was necessary to be done in connection with the business of the office. During the time I was in Montreal our staff consisted of four or five persons, Mr. Wood, our superintendent, myself as chief operator (and sometimes the only one), one or two clerks, and one messenger, a faithful old soldier, who delivered messages with a good deal more reliability than speed.

I remember well being terrified and almost paralyzed one day when the clerk from the outer office came rushing into the operating room in an excited manner, to tell me that Lord and Lady Elgin had called to see the working of the telegraph, and almost before I knew it they were both beside me as I was sending a message over the line. They were accompanied by Lady Alice Lampton and Lord Mark Kerr. Mr. Wood, our superintendent, soon came in, and relieved me from the duty of explaining to the distinguished party the working of the instruments.

The Postoffice Department, at the time I was in Montreal, was in charge of the English government, and the Postmaster-General, Mr. Stayner, was stationed in Montreal, as I have special occasion to remember. A mail steamer was one day reported from below in a message addressed to Mr. Stayner. Knowing that this news was being anxiously looked for, and on discovering that our only messenger was out on his rounds, I put on my cap and ran to the postoffice, a short distance up St. James street, without waiting to put the message in an envelope, and delivered it in breathless haste to the great man personally. Instead of receiving thanks, however, for my zeal, I was treated to the severest kind of reprimand for the liberty I had taken in delivering the message in such an informal manner. It is needless to say I never repeated the offence.

REMOVED TO TORONTO.

In the spring of 1850 I was sent to Toronto to take charge of the company's business here, and to be in a position to recommend such extensions in the province of Ontario as might seem desirable. During my first year in Toronto I sent and received myself on the instruments every message which passed over the line to and from this point. These messages were delivered by one small, freckle-faced Scotch boy, with a plentiful growth of hair on his head, named Robert Easson. I remember well how he ran with his messages as if his very life depended upon it. That boy is now in charge of our Press News Department, and is here to-night. You will notice that he has scarcely a particle of hair on his head.

I had not been long in Toronto before I began to suggest to the head office various extensions of our lines; and as these suggestions were almost invariably adopted, I grew bolder and more reckless, until the head office began to get nervous and frightened. It was finally concluded, however, and I was notified by Mr. Wood, our superintendent, that I should have carte blanche to do as I liked, it only being required that I should give notice each winter of what lines I proposed to build during the ensuing season. During the following years arrangements were made for building a line along the Great Western Railway, and from time to time other railways, as they were projected and built in Ontario, such as the Port Dover & Lake Huron, the Toronto & Nipissing, the Northern, North Simcoe, Port Hope, Peterboro & Lindsay, the Midland, Grand Junction, Victoria, Hamilton & Lake Erie, the Hamilton & Northwestern, the Lake Simcoe Junction, Welland, Whitby & Port Perry, the Victoria, the Toronto, Grey & Bruce, etc. Not only did we arrange to build lines along these different railways, most of which were afterwards consolidated with the Great Western, and the Great Western and finally all the others with the Grand Trunk, but we also covered all the principal highways in the province. I remember well an occasion when a rather sarcastic enquiry came

from the secretary of the Montreal Telegraph Company, as to whether I had found any more saw mills to which I proposed to extend the lines. The policy of extension adopted, however, turned out to be a fortunate one, and to-day the map of wires covering the country looks like a thickly woven spider's web, through which a fly could scarcely escape. There is hardly a town or village of the least importance in the country which is not included in this net work of lines, to say nothing of the present telephone system, so that instantaneous electrical communication is almost within the reach of every man's door.

I trust it may be considered a pardonable pride on my part that I have had something to do with the extension of an enterprise which has done so much towards facilitating the business and promoting the happiness of the Dominion and the world generally, and I have always esteemed it a matter for thankfulness that my attention was turned at an early time in this direction.

When I commenced my career as an operator there were only two railways in the country, a short line of nine miles between Montreal and Lachine and the other between Laprairie and St. Johns. There was not a mile of railroad in Ontario or any other part of the Dominion, and, as illustrative of how one enterprise may help another, it may be said that railway traffic is enormously increased by the assistance rendered by the telegraph in facilitating the movement of trains.

FROM HIGH TO LOW RATES.

The tariff on messages in the early days was reckoned in Halifax currency, not dollars and cents as now. On any extensions of the lines in any direction a small additional rate was charged on through messages, until finally, after a great many extensions had been made, the tariff became a complicated affair; charges ranging from 1s 3d to 5s or 6s, and it became a question for careful consideration as to how so complicated a scale might be simplified. My advice was asked for in the matter, and I procured statements from all the different offices showing the exact number of messages handled under the different rates. From these statements it was discovered that over 90 per cent. of the messages sent were under the lower rate, and, consequently, between offices nearest to one another. I submitted a report to show that the difference between these high rates and a uniform rate of 25 cents would involve no great loss to the company, even if there were no increase in the number of messages, while it would appear to the public a very great concession, and recommended that the uniform rate should be adopted, which was done. The consequence was that business soon began to increase between remoter points on the line, and the policy proved satisfactory to all concerned.

You are all well acquainted with the extraordinary development in the application of electricity, as shown in the telephone, electric railway, fire alarm systems, transmission of power, and in other directions. It has been a common saying ever since I entered the business that electrical development was only in its infancy, and, notwithstanding all that has taken place, I am still convinced that the saying is almost as true to-day as it ever was. Great as the development has been in the past, there is a vast field in the future yet to be occupied. Not only will every water fall and rapid be utilized for the production of electrical energy, but the force in every gale of wind will be called into use for the same purpose. Electric or trolley lines of railway will be extended over all the principal highways of the country, and all steam railways will be run by electric power. Our houses will not only be lighted, but heated, by electricity, and we shall require no more coal in our houses for any purpose. Horses will largely disappear, and we shall have better and cleaner streets. Tall and smoky chimneys will disappear. Every farmer will have an electric motor for use in his work of various kinds, and this wonderful energy will be conveniently available in cities and towns everywhere throughout the country for any and every purpose under the sun where power is required.

MANY INGENIOUS IMPROVEMENTS.

Our system of telegraphs is in some respects precisely the same as when I learnt the business fifty years ago, but there have been many ingenious improvements made in the instruments and in the use of the wires. One of these improvements is what is known as the quadruplex system—that is, the use of one wire between two terminal points, Toronto and Montreal, for instance, made to answer the purpose of four—one real wire, three phantom wires. Four operators do duty at each end of the line, and work independently, precisely as if there were four separate wires. Before this method of using the wires was discovered such a thing would have seemed as impossible as it would now to make a single

railroad track answer the purpose of four independent lines. Successful experiments have recently been made in sending messages for a considerable distance without any wires at all. These electrical matters are full of wonders. I never get into a trolley car but I think of how wonderful a thing it is that by mere contact with a slender overhead wire the power of 40 horses can be brought into the motor, as well as current that can be utilized to heat and light the car. It is a wonderful thing that a slender wire strung about the city should be made to burst out into a thousand brilliant lights at different points wherever required by the simple insertion of a certain amount of resistance to the flow of current at given points on the wire. It is a marvelous thing that by speaking into a simple little instrument, which contains a small metal disc, which corresponds to the drum of the human ear, our voices can be carried for 100 or 500 miles, and recognized by our friends at the other end of the wire, as distinctly as if we were together in the same room. These and other electrical developments are wonders which no man can explain. Can you wonder that such a business should be of sufficient interest to keep me in connection with it for 50 years? If I were to fall heir to a million dollars to-morrow I would ask leave of absence from my work long enough to visit Egypt, but only on the condition that I might return to my work again, and continue in it as long as possible. While the business with which I am connected has had its worries and anxieties, as well as other business has, its still retains for me its attraction, and I hope to be allowed to take an active part in it as long as I am able to be of any use or service.

It has been one of the pleasures of my later years to know that so many operators who learned their business upon our Canadian lines are now filling important positions with other companies. Upon taking a trip over the line of the C. P. R. to British Columbia, in company with my friend, Mr. Fred Nicholls, and returning over the Union Pacific, at many of the stations along the route, both coming and going, in British Columbia and the United States, I was constantly accosted by operators, station masters and others, who reminded me that they were once operators on our Canadian lines, and had kindly recollections of their Canadian associates. I have reason to know, for I have often been told, that Canadian operators are looked upon most favorably by their employers in the United States. During the American War some of the most expert field operators were Canadians, and the celebrated Southern Raider, Morgan, had on his staff an operator named Ellsworth, who became celebrated during the war, and who learnt his business in our Whitby office.

The Canadian General Electric Company have recently shipped to the Canadian Pacific Railway, for lighting their construction shops at Fort McLeod, N.W.T., a 400 light incandescent plant, from which constant potential arc lamps will also be operated.

A company from Bellechasse, Que., have asked for letters-patent, under the name of the Ste. Philomene Telephone Company. They will place telephones in the counties of Bellechasse, Montmagny and Dorchester, with headquarters at St. Raphael, and a capital of \$1,500.

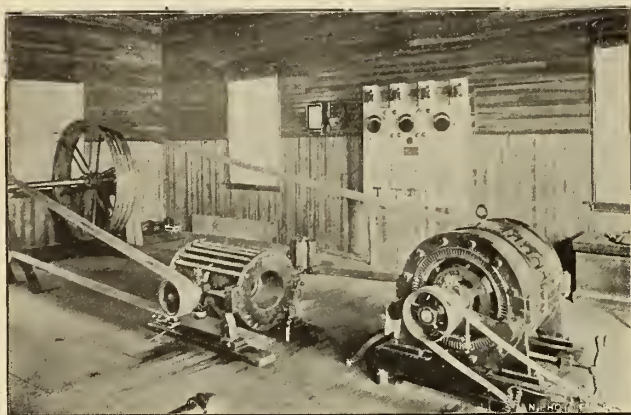
Friends of Mr. J. A. Kammerer, manager of the Toronto branch of the Royal Electric Company, will regret to learn that one week ago he was stricken with typhoid fever. Although the critical point has, perhaps, not yet been reached, it is hoped his constitution will prove sufficiently strong to overcome the disease, and that he may soon be restored to convalescence.

A comparative statement of earnings of the Montreal Street Railway shows the earnings for December last to have been \$113,128.91, as against \$103,116.02 in 1897, an increase of \$10,012.89. The total earnings for the first three months of the fiscal year, viz., October, November and December, were \$340,351.60, as against \$313,44.97, an increase for the three months of \$27,306.63.

The Guelph Light & Power Company have decided to replace their arc lighting machinery for supplying the street circuits with the latest and most approved machinery for the purpose, and have placed an order with the Canadian General Electric Company for an 80 light Brush arc machine, equipped with automatic regulator. These large Brush machines, of which eight, having a capacity of 125 lights each, have been purchased by the Toronto Electric Light Company, four of the same size by the Montmorency Company of Quebec, and four for direct connection to synchronous motors by the Lachine Rapids Hydraulic & Land Company, represent the successful development of arc lighting machinery along the lines which have been established as approved practice in direct current and alternating work.

THE GRAVENHURST LIGHTING PLANT.

THE town of Gravenhurst, situated at the south end of the Muskoka Lakes and a divisional point on the line of the Grand Trunk Railway, with its population of about 2,500, and its celebrated hospital for the cure of pulmonary diseases, since the fall of 1892 has enjoyed the benefits of electric lighting, having its streets illuminated by arc lights and its stores and residences by incandescent lights. The first electric light plant, installed by the Gravenhurst Electric & Trading Co., and situated in a lumber mill at the lakes, was operated with indifferent success until about a year ago, when it was pur-

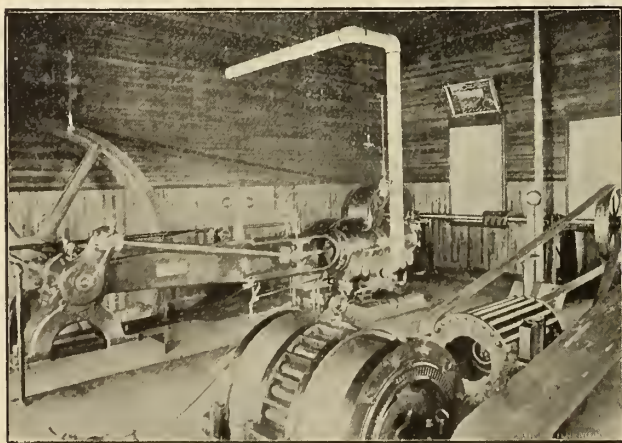


GRAVENHURST LIGHTING PLANT—VIEW OF GENERATORS.

chased by Mr. E. Fletcher, who formed the Gravenhurst Electric Light & Power Company.

The new company built a power house on the shores of Lake Gull, closer to the town, and with easy access to wood and water. The station is a substantial brick structure, and almost fire-proof. The new steam plant, of which a view is given, consists of a Wheelock engine of 150 h.p. and a boiler of the same size, both purchased from the Goldie & McCulloch Co., of Galt. This slow-speed simple condensing engine and boiler of the ordinary tubular flue style has proved to be an eminently efficient combination, and one with which the company is well satisfied.

Upon taking possession of the business, it was decided by the new company to remodel the entire old



GRAVENHURST LIGHTING PLANT—VIEW OF ENGINE ROOM.

plant. The primary wiring was overhauled, and the secondary system changed from 52 to 104 volts, substituting throughout Stanley transformers for those of the old type. In the station the old single-phase alternator of the revolving wire-wound type was replaced with a 50 k.w. S.K.C. two-phase generator, and the T.H. arc

system, which had given the old company good results, was kept in service.

The new plant was started about fifteen months ago, and from that day until the present time Gravenhurst has not been without light for street or indoor purposes. The company have now upon their system over 1,100 incandescent lights and 16 arc lamps, and Mr. Fletcher's management has proved a success both from an operating and financial standpoint.

The corporation of the town of Gravenhurst will in January next submit a by-law to the ratepayers asking



MR. E. FLETCHER,
Manager Gravenhurst Electric Light and Power Company.

for \$9,000 to purchase the electric lighting system and \$25,000 for a new waterworks system.

SAMPLES OF SCALE AND FEED WATER WANTED.

MR. Wm. Thompson has in course of preparation for this journal a series of articles on "Corrosive and Scale Forming Agents in Boiler Feed Waters." To make these articles of special value to our readers, Mr. Thompson wishes to receive from responsible steam users in all parts of the Dominion samples of scale and feed water, accompanied by as full particulars as possible. It is Mr. Thompson's intention to make complete analysis of the various samples, using them as practical illustrations of the formation of scale through various sources. These samples should be addressed to Mr. Thompson at Montreal West, Que.

THE TORONTO ELECTRIC LIGHT COMPANY'S ALTERNATING PLANT.

THE Toronto Electric Light Company are now installing in their new station four 200 kilowatt, 60 cycle single phase alternators of the Canadian General Electric Company's latest type. These machines are of the iron-clad armature type, and embody the most recent improvements in the design and manufacture of alternating generators for lighting service. They will be belt driven from the large vertical engines recently installed for the company by John Inglis & Sons, each engine driving a pair of alternators and a 450 kilowatt direct current generator.

The plant of the Phelps Machine Co., of Eastman, Que., has been bought out by the Jenckes Machine Co., of Sherbrooke, who will continue the manufacture of the Dake engine in their Sherbrooke works.

THE STEAM ENGINE GOVERNOR AND ITS REGULATION.*

THE matter of governing steam engines for a uniform speed under the greatest variation of load and steam pressure, and the economy in the use of steam, is no doubt one of the principal features in steam engineering, and I believe the same is absorbing more thought and receiving more attention from the engineer and engine builder than any other adjunct of the steam engine to-day. I will endeavor to point out the fundamental principle upon which the governor acts, and why it acts. There are two conditions of principle, one known as the centrifugal and the other inertia action. The ordinary centrifugal fly ball governor consists principally of a pair of cast iron balls or weights suspended on an arm and at an angle of about thirty degrees from its vertical axis, and made to revolve round its axis as free as possible, generally driven by a pair of mitre gears. This principle of fly ball or centrifugal governor was embodied in the first governor invented by James Watt, which has been more resorted to than any other, but aside from this the governor has been so improved, altered and reconstructed since its time as to be almost unrecognizable. Still the old principle is there, as well as nearly all, if not all, the prominent defects which so materially interfere with its efficiency. The three principal defects are: 1st, friction; 2nd, unbalanced force, caused by the different position of the levers and arms; 3rd, unequal resistance offered to counteract the centrifugal force.

Now, we will take the first, friction. It may be said it has been fairly well overcome for the most practical purposes, so far as the builders are concerned; but much depends on the engineer, as it is his place to see that no excess friction is allowed through improper lubrication of the working parts, poorly packed valve stems, etc.

Then the second is unbalanced force. This defect appears to be much more difficult to overcome and is certainly a greater detriment to the action of the governor. Like other parts of the steam engine, some governors are designed much worse than others in this respect, but the best of them are a long way from being perfect, and the reason may be explained in this way: Suppose, we take, for example, the ordinary centrifugal fly ball governor, and assume that the balls are travelling round in their normal plane, and that the arms are at an angle of 45 degrees and travelling through the path of a 12 circle. The engine is now running 100 revolutions per minute, and the mean effective pressure is 40 pounds. So long as these conditions are left that way, and there is no change in the load, the speed of the engine will be most perfect. But we cannot maintain this, so we will suppose the first change to be that the steam pressure shown by the gauge is allowed to increase. Now, then, the mean effective pressure becomes greater and the engine begins to move faster, and the governor in turn; now there has been a change. The balls have moved to a higher and wider plane. This change simply means that the line of force has become closer to right angles with the vertical axis of the governor, therefore travelling through a greater radius, and the line through the point of gravitation has become farther away from the fulcrum, therefore the speed has to be increased to overcome the increased weight of gravity, caused by the change of angularity, and so the engine continues to increase in speed until enough momentum has been stored to balance the balls in their new position. Therefore it is quite consistent that the force that will support the balls in one plane will not support them in a higher one. Consequently the speed of the engine must vary when controlled by such a governor.

The third was said to be unequal resistance offered to counteract the centrifugal force. This is sometimes applied by a lever and ball and sometimes by a spring. Where the ball is used we still have the same trouble as in the second fault, namely, angularity, and where the spring is used, it is much worse than the ball, because the tension of the spring increases as the spring is drawn out. For example, if we have a spring attached, and offered 20 lbs. resistance when it was drawn out say one inch. Supposing now that part of the load was thrown off, the balls would then have to be speeded up to a higher plane, say enough to cause the springs being drawn out another inch; then the spring would be holding 40 lbs. and of course the balls would have to be speeded fast enough to support this extra 20 lbs. Possibly this might mean two or three revolutions faster for the engine.

The object of applying resistance to the governor may be said

to have two purposes: First, to assist the gravitation of the balls when coming to a lower plane, and, second, to permit the changing of the speed of the engine by adjusting the ball or spring until the required speed is maintained.

This resistance, however, has been made automatically adjustable by several inventors in the last few years. This has bettered matters considerably, but still the speed of the engine must change before the attachments are caused to act. So, as it is, the engine has first felt the change of load, causing it to slow up in speed, then the governor feels the change, which in turn causes the attachment to act, therefore it is just a little too late in acting, as the speed has already slowed up, but if the governor had felt the change before the engine, then things would have been different; and so it is with the centrifugal governor that the momentum has to be increased to act one way, and decreased to act the other way. Now, I will leave the centrifugal governor and take up the other principal of governor called inertia. As it would make this paper very lengthy to go fully into this, I will only endeavor to touch on a few principal points.

First, we will suppose this to be connected as a shaft governor. The principal part of this apparatus consists of one straight arm with a fixed weight on each end, and pivoted in the centre to a fixed point of the wheel near the centre of the shaft, thus allowing the balls to move in a rotating direction only, and always in the same plane, thereby doing away with the troublesome change of angles as well as the use of the centrifugal action; there is a spring attached to the arm about the centre of its radius and the other end to the rim of the pulley which surrounds the governor. This spring is used to offer resistance to the acting energy of the rotating weights, and also to assist the momentum in opening the valve. It will be seen that when this apparatus is put in motion the pulley and engine will gradually advance ahead of the suspended weights and continue on so until the valve is adjusted to the proper cut-off to balance the load, and when any extra load is felt by the engine the weights will continue to go on in advance of the engine, thereby increasing the travel of the valve and permitting a later cut-off. So with this apparatus there is no reversing of motion before the governor responds.

ERRATUM.

In the paper on the "Indicator" read by Mr. Wickens and published in our last number, two errors occurred. The last sentence of the paragraph ending nearly the centre of the second column should read as follows: "The height of the diagram at the first point of measurement is $\frac{3}{4}$ less than two inches, and represents 77 lbs.; the second is exactly 2 inches, representing 80 lbs.; 3rd, 80 lbs.; 4th, 57 lbs.; 5th, 41½ lbs.; 6th, 34½ lbs.; 7th, 27 lbs.; 8th, 20 lbs.; 9th, 16 lbs.; 10th, 13 lbs., making a total of 446." In the eighth line from the end, the words "piston across head" should read "piston and cross head."

ENJOYS IT VERY MUCH.

MR. Geo. W. Vincent, of Acton, Ont., in remitting his subscription to the ELECTRICAL NEWS, writes: "I enjoy the paper very much, and hope to continue taking it."

The board of directors of the Hull Electric Company have appointed Mr. W. R. Taylor as secretary-treasurer.

A meeting was held at Bobcaygeon, Ont., to consider the question of building an electric railway connecting Fenelon Falls, Bobcaygeon and Peterboro'. A committee was named to obtain particulars and report. Mr. W. J. Read is acting secretary.

Special illustrated articles in the January Cosmopolitan are: "The Real Klondike," by J. S. Easby-Smith; "The Great and Small of Family Trees," by A. L. Benedict; "An Island on the Georgia Coast," by John R. Van Wormer; and "Some Society Tableaux," by M. E. W. Sherwood.

Mr. A. Drouin has been appointed engineer at the city hall, Montreal, to succeed Mr. Felix Decarrie. The following persons were applicants for the position: J. O. Joly, Thomas McHugh, E. J. Hatton, N. E. Barsalou, William Morrow, A. Drouin, Alph. G. Lapointe, S. Richard, M. E. Bellevance. Mr. Drouin has been in the service of the corporation for eight years and is attached at No. 10 station. He has a certificate of inspector of boilers and was formerly attached to the steamer Miramichi. For five years he has been president of the French section of the Stationary Engineers. The present assistant, William Morrow, has been permanently appointed on the staff.

* Paper read by Mr. F. G. Mitchell, president Ontario Association of Stationary Engineers, before the Hamilton branch, C A S. E., December 28th, 1897.

STEAM AND ELECTRIC PLANT AT THE FORESTERS' TEMPLE.

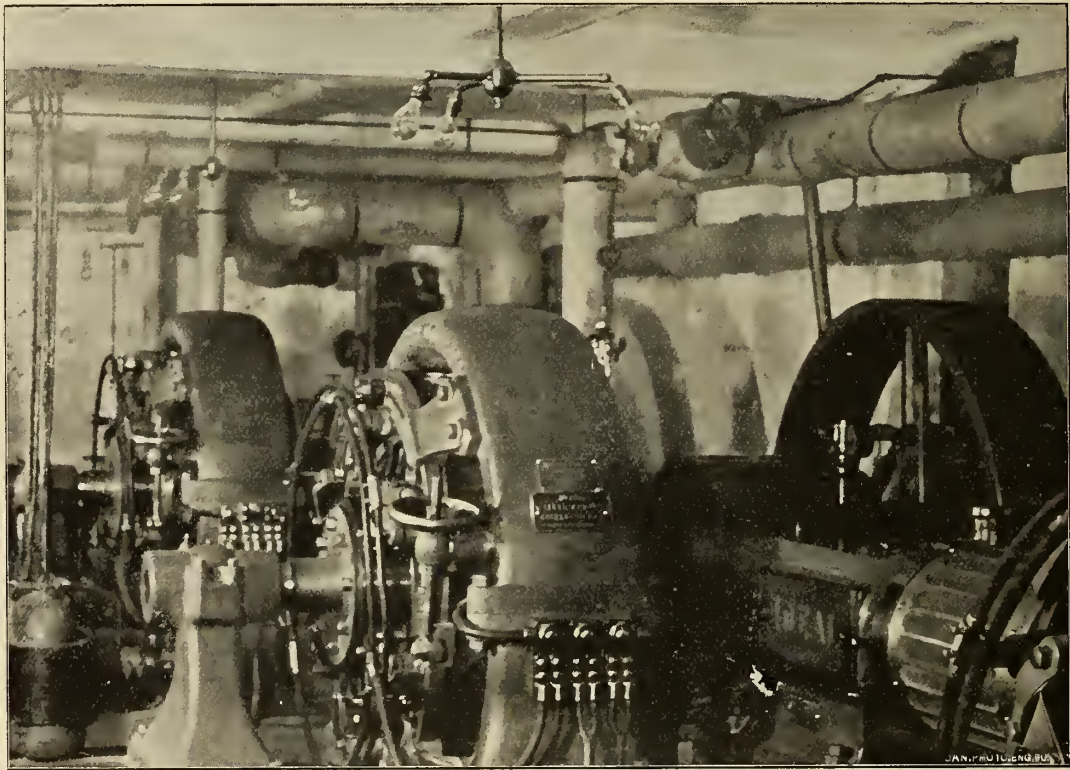
PERHAPS the largest isolated lighting plant yet installed in an office building in this country has recently been completed at the new Foresters' Temple, corner Bay and Richmond streets, Toronto. This building is one of the most modern in Canada, is ten stories in height, with a frontage of 96 feet on Bay street and 132 feet on Richmond street. In keeping with the general high-class character of the building is the steam and electric plant, an inspection of which was made by a representative of the *ELECTRICAL NEWS*. The general arrangement of the plant is such as to insure the greatest convenience and economy of operation, the apparatus being of the most improved type and reflecting credit alike upon the owners, architect and contractors. From a brief outline of the installation some points of interest and instruction may be gathered.

The boiler room, located in the southern portion of the basement and beneath the Richmond street sidewalk,

by a by-pass. This device simply permits sufficient steam to enter to keep the engine off the centre. The Sturtevant fan and 6 h. p. engine was also supplied by the Weeks-Eldred Company. The belt connecting same, furnished by the A. R. Williams Machinery Co., is laced with wire, making it appear endless. The fan also draws air from the boiler room, ventilating this room and supplying the furnace with air.

Coal screenings are used for fuel. These are unloaded direct from the wagon to the storing bins and conveyed to the furnaces by means of a trolley, the track extending from one end of the boiler room to the other, with switches, Mr. R. L. McIntyre, of Toronto, being the builder. An hydraulic hoist provides a convenient means of disposing of the ashes. This hoist can be drawn about 3 feet 6 inches above the sidewalk, thus placing it on a level with the wagon and rendering loading and unloading comparatively easy.

Passing to the generating room, 50 x 32 feet in size, with concrete floor, we first reach the electric generators



ELECTRIC LIGHT PLANT, FORESTERS' TEMPLE, TORONTO.—VIEW OF GENERATORS.

is oblong in shape, being about sixteen feet wide and extending nearly the total length of the frontage, some 130 feet. Luxfer prisms in the sidewalk provide the required light, thus removing the necessity of artificial lighting. The battery consists of two Heine boilers of 120 horse power each, manufactured by the Canadian Heine Boiler Company. Instead of being placed side by side as is usually the case, these boilers are set in line, the arrangement bringing the fuel door of each boiler in close proximity to the coal bunkers, of which there are two, one at each end of the boiler room. The boilers are guaranteed at 50 per cent. above rated capacity, and are fitted with two Jones' Underfeed Mechanical Stokers, built by the Weeks-Eldred Company. In connection with these stokers is one of McDonough's electric damper and pressure regulators, working on a quick opening valve on steam line, connected to a six horse power engine driving a No. 7 Sturtevant fan forcing air into the furnace, and so arranged that when steam is at 90 lbs. the engine is cut down and simply kept moving

and engines, the contract for which was completed in a highly satisfactory manner by the W. A. Johnson Electric Company, of Toronto. Three direct current 50 kilowatt Walker generators, for which the above company are Canadian representatives, are direct connected to "Ideal" engines, 12 x 12, the latter manufactured by the Goldie & McCulloch Company, of Galt. One of these generators is wound for 250 volts, is running at 275 revolutions per minute, and is supplying current for motors and electric elevators. The motors drive the fans for ventilating purposes, and will also be required for other power service. The other two generators are wound for 125 volts, and are furnishing current for electric lighting throughout the building, which is wired for a capacity of 2,800 16 c. p. lights. In addition to these generators there is a motor generator of 80 lights capacity, built at the works of the W. A. Johnson Electric Co. This machine takes current from the power generator and supplies lighting during the day-time. This portion of the installation has many points of merit, the

three direct connected generators only occupying a space of about 12 by 33 feet. The economy in space by means of the direct connected generators is a great consideration in plants of this character, and should result in the almost universal adoption of this type of machine. The running of the engines and dynamos is practically noiseless, and not a spark can be seen on the generators. They are also perfectly dry, and persons can place their hands on any part without feeling the least current. The carbon brushes are provided with a new patent brush holder, which permits of proper regulation in a simple manner. No adjustment of brush swivel is necessary for changes of load on dynamos. The above machines have a greater capacity than those of any other isolated plant in an office building in Canada.

The switchboard and wiring were contracted for by the Bennett & Wright Company, and are most complete. The switchboard is arranged so that the entire lighting and power service in the building will be controlled by the switches mounted thereon. It is constructed of white Italian marble on an iron frame, 15 feet 6 inches in length by 7 feet high. The board is set 2 feet 6 inches out from the wall, and all connections made at the rear. There are seven panels in all, six being provided for switches and a seventh for pressure gauges, pneumatic clock and Paul system jets. Of the six panels referred to three are provided for the generator, each having double pole main switch, field rheostat and Weston volt and ammeter. One panel has the four power service switches for elevators and other motors, and two double throw main switches, by means of which the entire lighting and power service may be thrown instantly from the generators before mentioned to the Toronto Incandescent Company's service, or vice versa. The other two panels contain the lighting service switches for the building, of which there are thirty-six. All the switches except for equalizer are double pole and have fuse terminals.

The wiring throughout the building is most secure, Habershaw wire in iron-armoured conduits having been used. The wires are continuous and always accessible, and can be drawn out and replaced at any time. The distributing circuits throughout are connected to slate tablet boards, no porcelain cut-outs being used.

Next we come to two boiler feed duplex pumps, $7\frac{1}{2} \times 4\frac{1}{2} \times 10$, made by the Northey Mfg. Company. An Excelsior feed water heater, purifier, filter and oil separator is located near these pumps, and is a device especially worthy of mention. It is manufactured by the Excelsior Heater Company, of Chicago, and was installed by the Bennett & Wright Company. A few words of explanation may here be required, as it is claimed that this is only the second machine of the kind to be introduced in Canada, the other one being in the new municipal buildings in Toronto. The building is heated by the exhaust steam from the engines by the one pipe overhead system. When the steam reaches the separator, all the oil and grease is exhausted therefrom, and it passes to the heating mains and is supplemented through a pressure reducing valve with live steam as required. The condensed water returns to the heater, is pumped back to boilers and used over again. By this arrangement it is possible to exhaust into the heating system or direct into the atmosphere. The pumps work automatically by float attached to quick-opening valve.

Another interesting feature of the plant is a duplex

air pump, made by the Johnson Electric Service Company, of Milwaukee, its purpose being to pump air to control the diaphragm air in the radiators. There is also a water plunger pump for same purpose, to be used as an auxiliary, and two air storage tanks in connection therewith attached to the ceiling. The steam pump works automatically by a governor. To provide ample fire protection is an underwriters' fire pump, $14 \times 7 \times 12$, built by the Northey Mfg. Co., and of a capacity of 500 gallons per minute at a pressure of 250 pounds to the square inch. A twelve-ton ice machine built by the Buffalo Refrigerator Co., and used for cooling air for ventilating purposes, a Tobey water heater supplying hot water to all lavatories throughout the building, and a Westinghouse air pump for operating the pneumatic gates on elevator enclosures, are other interesting features of the plant. These pneumatic gates are splendid safety devices, it being impossible to open them excepting when the elevator is level with the floors, and then all that is required is to simply touch a button. In the building are three Standard elevators, which run on the low amperage of 50 amperes at full load. The easy motion in starting and stopping and the smooth running of these elevators is the subject of comment by passengers. A novel device in connection with them is an indicator, which indicates to passengers desiring to ascend or descend just where the elevator is, and whether it is going up or down.

The two boilers are connected by a four-inch pipe, and extending from this connection to the engine is a six-inch pipe. The distributing pipe for the heating system is twelve inches in diameter, and from it the various riser pipes are taken. The steam pipes are protected by mineral wool from the works of the Toronto Mineral Wool Company. The exhaust pipes are placed under the floor, with removable metal plates covering them.

Adjoining the engine room is the supply and repair department, 50×20 feet, well equipped with cupboards for storing electric lamps, tools and general supplies, oil tanks, pipe racks, drawers for fittings, etc. The space devoted for this purpose permits of everything being arranged in the best possible manner.

The complete electric and steam apparatus and fixtures, excepting the dynamos and engines, were contracted for by the Bennett & Wright Company, who are among the foremost experts in their line in Canada. Mr. T. F. Pickett, foreman electrician for the company, had charge of installing the electric fixtures throughout, including switchboard and wiring, and nothing more than an inspection of the work is required to convince one of its thoroughness.

Mr. G. A. Wilkie is chief engineer, and upon him devolves the duties of the mechanical superintendence of the building. In Mr. D. A. Dixon he has a valuable assistant. To these gentlemen the writer is indebted for courtesies extended while obtaining the above description.

Mr. R. Mackie has been appointed chief engineer of the new sewage disposal works at Hamilton. Mr. Mackie holds a first-class certificate, and has been engineer at the Hamilton Bridge and Tool Works, Copp Bros., and the Rolling Mills.

The Shawenegan Manufacturing Company has asked for letters-patent of incorporation, with a capital of \$500,000. Its object is to develop the water power of the St. Maurice river, in the province of Quebec, for the production of calcium carbide and electricity. Among the promoters are Peter Lyall, contractor, Montreal, and Charles Riordon, paper manufacturer, St. Catharines.

CORROSIVE AND SCALE-FORMING AGENTS IN BOILER FEED WATERS.

By WM. THOMPSON.

INTRODUCTION.

IN introducing the above subject to the readers of the CANADIAN ELECTRICAL NEWS, I do so with a great deal of pleasure. Generally speaking, no branch of steam engineering receives less intelligent attention on the part of steam users and engineers than does this most important subject. The great importance of the subject itself is but vaguely understood, and the attention it generally receives is of a kind that in the interests of either economy, safety or science, might be very easily dispensed with.

It has been my privilege during the last few months to have handed to me samples of feed water and boiler scale from every part of this Dominion. An examination of these proves to me the great necessity of the whole subject being discussed in a thorough manner.

I do not hope to add any new scientific facts on this subject, but rather to make present well-known facts plain to my readers. For this reason I shall endeavor to confine myself to the four general headings:

1st. The presence of corrosive agents in feed waters—their nature and action on the boiler plates.

2nd. Scale-forming agents and nature of scale formed by different materials.

3rd. Combined action of scale-forming and corrosive agents.

4th. Reaction necessary to prevent the formation of scale.

This covers an immense field, and entails a lot of labor, which I cheerfully undertake for the mutual benefit of myself and fellow engineers, my only cause for regret being that a more able Canadian engineer has not seen fit to undertake the task.

I have to thank those of you who so kindly placed feed water and scale at my disposal, and sincerely hope that a perusal of these articles will amply repay you for any trouble you have taken in this respect.

Very truly yours,

THE AUTHOR.

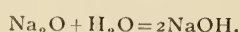
[ARTICLE I.]

Water is universally conceded to be the greatest of all known solvents, consequently it never occurs in a state of purity as a natural supply. The foreign matter may be composed of either solids or gases, or both, and may be in suspension, mechanical or chemical solution with the water. By the term suspension is meant a state in which the foreign matter is present in the water in its original state, no matter how finely divided, and when it can be abstracted from the water by filtration, having the same properties as when it entered the water in the first place.

In boiler feed waters this usually consists of vegetable organic matter, finely divided clay, etc. The coarser and heavier the particles the sooner will they separate out and settle to the bottom of any receptacle in which water may be contained. It is possible, however, to find water with foreign matter in suspension so minutely divided that it is impossible to detect them except by slight turbidity or characteristic coloring given to the water. I have in my laboratory samples of water taken from freshly drilled artesian wells in the vicinity of Montreal, containing particles of clay held in suspension so minutely divided that it took weeks for complete settlement to take place, and the slightest movement of the containing vessels would cause particles to again rise in the water, thus causing turbidity.

Matter in mechanical or physical solution, on the other hand, has entered into combination with the water and cannot be again abstracted except by means of a change of state or evaporation. For instance, to pure, distilled water add common salt; this at once dissolves, and until water is saturated, if salt was pure, no apparent change takes place in the appearance of the water itself, and if solution was passed through the finest possible filter, salt would still remain in solution, but if we carefully evaporate off the water, salt will finally remain in its original state, no evident change having taken place.

If to pure water (H_2O) we add oxide of sodium (Na_2O), soda at once combines with the water, or part of it, with generation of heat, a chemical reaction taking place in accordance with following equation:



In this case one molecule of sodium oxide enters into combination with one molecule of water to form the new chemical compound, sodium hydroxide, which dissolves in the excess of water present, and remains in chemical solution; and if water

was evaporated off, sodium oxide would not be recovered in its original state as an oxide, but in the state of sodium hydroxide.

The reader will note the difference here. On the one hand, addition of sodium chloride to the water made no apparent change in general appearance of water to the naked eye, and no heat was evolved, and on evaporation it was again recovered in its original state, and without any change in weight. In this case salt simply entered into mechanical solution with the water, due to the solvent powers of that menstrum, and is really but a physical change. In the other case, sodium oxide first entered into chemical combination with a portion of the water (due to the chemical affinity of the one compound for the other) with evolution of heat, and excess of water present dissolved new chemical compound, which then remained in chemical solution. On evaporation solid sodium oxide would be found to have gained in weight in direct proportion with the number of molecules of water required for chemical change from the oxide to the hydroxide.

Changes of this description are constantly taking place, and it is with these we shall particularly deal at a later stage in these articles.

Not only do a great many solids dissolve in water to a greater or less extent, but many gases also dissolve very readily, and to these can be traced phenomenon occurring in some feed waters known as pitting corrosion and grooving.

The first of these may be very properly described as corrosion, occurring in small spots on parts of a boiler, and is quite distinct from general corrosion, which wastes away an extended area of surface. Pitting is both annoying and generally very destructive, in some cases burrowing holes through the affected parts of a boiler as completely as if it had been drilled. This action was formerly and is to-day occasionally attributed to poor material used in construction, the theory being that weak spots exist and are attacked by corrosive agents found in the material itself. There remains practically no doubt but that a condition of affairs of this kind existing would have an effect on the boiler parts, and would facilitate the pitting action. An explanation of this kind falls very far short of a satisfactory answer, however, in either theory or practice, as it is applicable to very few cases.

Careful experiments made by leading chemists and a review of the whole subject go to prove quite conclusively that pitting occurs most frequently when gases are found dissolved in the water, oxygen and carbonic acid gas being the most active agents, and more especially when present together. These gases under certain conditions are very soluble in water, and in examining a water for boiler feed purposes require just as careful consideration as does dissolved solid.

Atmospheric air dissolves in water very readily, and contains at all times a certain percentage of carbonic dioxide, and here a very peculiar fact is to be noted that has an important bearing on the point before us. It is a well known fact that atmospheric air is composed of nitrogen and oxygen in mechanical combination, four of nitrogen to one of oxygen by volume, or very nearly 79 volumes of nitrogen to 21 of oxygen. When atmospheric air is dissolved in water these proportions are found to have changed, said to be due to the greater solubility of oxygen in water.

It is worthy of note that water dissolves very unequal quantities of the different gases, and very unequal quantities of the SAME GAS, at different temperatures. One volume of water absorbs at the temperatures stated in the following table under atmospheric pressure equal to 30 inches of mercury, according to Bunsen, the following volumes of the different gases:

Degrees. Fah.	Oxygen. (O)	Nitrogen. (N)	Hydrogen (H)	Carbon Dioxide. C O ₂	Chlorine. Cl	Sulphur Dioxide. S O ₂	Hydric Chloride. H Cl
32°	.041	.020	.019	1.80		53.9	505
50°	.033	.016	.019	1.18	2.59	36.4	472
68°	.028	.014	.019	.90	2.16	27.3	441

While not altogether applicable to our point, it may be stated that as the pressure increases a correspondingly larger quantity of the gas is absorbed, and as the temperature increases the solubility of the gas decreases in many cases. (Carefully refer to table on this point.) It is, however, important to note that the pressure which determines the rate of absorption of a gas is not the general pressure to which the water or other absorbing liquid is exposed, but that pressure which the gas under consideration would exert if it were ALONE PRESENT in the space in which the absorbing liquid is in contact. It is necessary to bear this in mind to understand why atmospheric air absorbed by water differs in composition from ordinary air.

As I have said, atmospheric air consists of 79 parts of nitrogen

and 21 parts of oxygen. In atmospheric air, acting under a pressure of 30 inches of mercury or one atmosphere, the oxygen exerts a partial pressure of $\frac{21}{100}$, and the nitrogen $\frac{79}{100}$. At 50° F, according to table, one volume of water at atmospheric pressure absorbs .033 volume oxygen and .016 volume nitrogen, supposing these gases to be in a pure state. Then under the partial pressures above indicated water cannot absorb at 50° F. more than $\frac{21}{100} \times .033 = .007$ volumes of oxygen and $\frac{79}{100} \times .016 = .013$ volumes of nitrogen.

Then, in $.007 + .013 = .020$ volumes of atmospheric air absorbed by water there are consequently .007 oxygen and .013 nitrogen, or in 100 volumes, 35 volumes of oxygen and 65 volumes of nitrogen. Atmospheric air then dissolved in water is seen to be very much richer in oxygen than is the air itself in its ordinary condition. This fact is in itself worthy of the most careful consideration, and explains clearly what is too often considered purely accidental phenomena.

Before proceeding to discuss what action takes place during the act of pitting, I wish to digress from the subject to point out to the reader that the capacity of water to absorb gases of fixed chemical compounds, such as carbonic dioxide (CO_2), sulphur dioxide (SO_2), and hydric chloride (HCl), must not be confounded with the behavior of atmospheric air. Thus hydric chloride must not be understood as being absorbed by water in the same proportions as its elements, hydrogen and chlorine. It is a complete gaseous chemical compound of itself, and combines as such; in other words, nitrogen and oxygen retain their own peculiar properties in atmospheric air, but just as soon as hydrogen and chlorine combine together to form hydric chloride, an entirely new chemical compound is formed, with quite different properties from the elements of which it is composed, and with entirely different degrees of solubility.

When water is strongly heated for a long time, atmospheric air is completely expelled, and at once resumes its normal composition; thus we have present a quantity of free oxygen, which is the cause of a great deal of our trouble. While the action of oxygen on iron is well understood, it is not easy to explain the action of gases producing pitting in a steam boiler, particularly to explain why isolated spots are attacked while surrounding metal remains unaffected. If we heat water gradually in a glass retort, open to the atmosphere, bubbles of gas or air expelled from the water are seen clinging to the sides and bottom; and if we purposely scratch the inner surface of the glass, or in other manner create an imperfection of a similar nature, it presents a wonderful attraction for these little bubbles, more collecting there than at any other part of the retort. And so tenaciously do these bubbles cling to their selected places that it requires considerable agitation to remove them.

In steam boilers the same conditions prevail, and there remains but little doubt that these bubbles contain free oxygen and other gases in a favorable condition to act on the metal beneath. Temperature being high, they necessarily act with a great deal of rapidity. When the oxygen has combined with the iron of the metal, protoxide of iron (FeO) is formed, and a little excrescence appears on the surface of the metal, due to the expansion of the iron by the addition of oxygen, and occupying more space than the iron acted upon. Subsequent expansion and contraction causes this small excrescence to burst, and leaves a small pit or roughened surface, which readily attracts the gas bubbles, and the process is again repeated until finally a hole has been eaten a considerable distance into or completely through the part affected.

(To be Continued)

NEW ARC LAMP.

THE accompanying cut represents a new type of arc lamp recently placed on the market by the Canadian General Electric Company. This company announce that they are now prepared to furnish a satisfactory and economical arc lamp for constant potential, alternating current circuits. The problem is said to have been a difficult one to solve, but the results obtained are claimed to be such as to warrant any apparent delay.

The principal features of the new lamp are briefly as follows: Small maintenance account, by reason of a life of 60 to 70 hours, with one pair of carbons; the lamp is simple in construction, has few moving parts and operates quietly; great economy, ninety-three per

cent. (93%) of the energy being utilized in the arc; operates independently on circuits of 100 to 120 volts, and frequencies of 60 or 125 cycles.

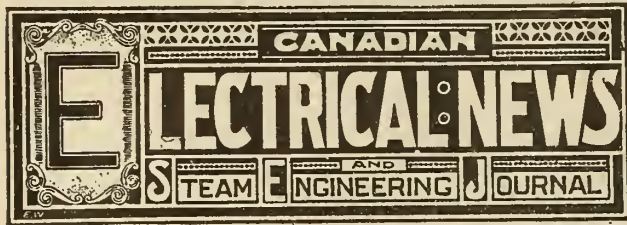
The lamp requires 70 volts potential to the arc, and consumes six amperes. The difference in the potential at the arc and at the terminals is taken up by an inductive resistance, which is the unique feature of the lamp. This inductive coil does not consume in excess of 25 watts, and is placed within the interior of the



C. G. E. COMPANY'S NEW ARC LAMP.

ornamentation. The use of high grade carbons is essential. The lamp is artistic in appearance and especially suitable for interior illumination. The ornamentation is finished in ground brass and black enamel. The company are also prepared to furnish a weather-proof lamp suitable for outside service.

The renowned LeRoi Mines of Rossland, B. C., are extending their pumping system, and have placed an order through the Rossland branch of the Jenckes Machine Co., Sherbrooke, Que. for a large size special Knowles sinking pump.



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EDITOR'S ANNOUNCEMENTS.

Correspondence is invited upon all topics legitimately coming within the scope of this journal.

The "Canadian Electrical News" has been appointed the official paper of the Canadian Electrical Association.

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Few street railway managers are aware of the importance of teaching their motormen to economize power by an intelligent handling of their controllers. The controller is intended to take the place of the old method of slowly accelerating cars, and of avoiding a rush of current through the motor when at rest, and instead of simply interposing a resistance in series with the motor which can be gradually cut out, it so arranges the armature and field coils of two motor cars as that they are all placed in series with each other at the start, so that each motor actually has then a difference of pressure of about 250 volts across its terminals, without their having been any useless consumption of power in a rheostat. The idea of this is, of course, in order that there may not be a sudden rush of current through the motor, which would be the case if it were subjected, when at rest, to a pressure of 500 volts. When it has accelerated to some extent, then a second step of the controller throws each motor in parallel with its own fields, but in series with the other motor, which combination reduces the total resistance and more current flows, until finally, after the successive steps of the controller have been finished, both motors are in series with their own fields and in parallel with each other, each one taking the full 500 volts. A speed regulation is also often effected by manipulating the controller, it being kept at some intermediate position when it is desired to run slowly, or creep up to some stopping point. Any position, however, except the last, that is, the motors in series with their fields and in parallel with each other, causes the motors to work at very low efficiency, and should be avoided as much as possible. If it be desired to go slowly it is better to open the controller full for a few moments periodically and then shut it right off, "drifting" until the speed becomes too low, and then opening full again and so on, rather than to run at any

intermediate point. A little practice will soon enable an intelligent motorman to run slowly and smoothly. It is also preferable to use a break strongly to stop, than to slow down by intermediate steps.

The Chambly Power Plant. A NUMBER of prominent persons last week made an inspection of the works of the Chambly Manufacturing Company, now in course of construction at Chambly, Que., and a description of which appeared in the ELECTRICAL NEWS for December last. The party included Mr. F. S. Pierson, chief engineer of the Metropolitan Traction Company, of New York, and several officers and directors of the Montreal Street Railway Company. A thorough examination of the entire plant was made, and the unanimous expression was that the works were of the highest possible character. This opinion from an expert such as Mr. Pierson must be a source of gratification alike to the promoters of the undertaking and the citizens of Montreal and vicinity, who will be consumers of the current.

Guaranteeing Street Railway Bonds. A BILL has passed the Ontario Legislature which is regarded as being somewhat of an innovation. It provides that the city of St. Thomas shall guarantee the Street Railway Company's bonds to the amount of \$50,000, to enable the company to electrify its street railway system. In the event of the company failing to keep up its payments on the bonds, the city is permitted to take over the road and operate it. Hon. Mr. Gibson, in referring to the bill, stated that the provision for municipal operation was something that had never been introduced in the Legislature before, but he believed that in the modern view such powers were proper ones to bestow upon the municipality.

Decision as to Smoke Consumers. A BY-LAW of the city of Montreal provides that steam users must equip their plants with proper apparatus for consuming the smoke. An action was recently entered in the Recorder's Court by the Boiler Inspector against a saw-mill owner for not complying with the provisions of the law. The defendant contended that residents in the vicinity had entered no complaint, and that, owing to an increase in the height of the chimney, no nuisance now existed. The court, however, decided against the defendant, pointing out that according to law every steam user was obliged to provide smoke consuming apparatus, and no complaint from the neighbors was necessary. The decision was looked forward to with much interest, as a number of similar cases were pending at the time, which were subsequently dealt with in a like manner, the Recorder allowing eight days in which to provide the apparatus. It is claimed that in the city of Montreal ninety-seven factories are equipped with means of consuming the smoke, while perhaps five times that number of establishments contain steam boilers. It is quite probable that action will be taken to compel every steam user to comply with the law, in which case the manufacturers of smoke consumers will reap a harvest. In Toronto the law in this respect differs from that in Montreal, inasmuch as only when the smoke from a factory can be shown to be offensive or destructful are steam users compelled to provide a remedy. A number of the largest manufacturers, however, have found it profitable to equip their plants with mechanical stokers, which besides effecting a large

saving in fuel, also remove the necessity of providing smoke consumers, owing to the method of firing employed. As the number of steam plants in Toronto and other large cities becomes greater, it may be found necessary to adopt regulations such as those in force in Montreal.

Electric Cabs vs. Street Railways. MR. A. H. St. Germain, of North Toronto, has announced his intention of organizing an autocar service between York Mills and the city of Toronto. He is said to have ordered three electric busses from an English firm, to be delivered early in the spring. This service will come in direct competition with the Metropolitan Street Railway, and may also affect the receipts of the Toronto Railway Company. The success of the venture will therefore be watched with more than usual interest. The electric cabs will be entirely different from any heretofore seen in Canada, and will have a carrying capacity for thirty passengers, which would seem to strengthen the probability of their successful competition with street railways. In London, England, these cabs are becoming a familiar sight, and are believed to have passed the experimental stage so far as energy is concerned, but the cost of the maintenance of the battery is a point that has not as yet been demonstrated. While not forecasting any serious loss of revenue to the street railways effected, the proposition made by Mr. St. Germain is doubtless of some interest to street railway companies as showing what may be attempted at other places under similar circumstances. The reason for Mr. St. Germain's decision to inaugurate such a service is probably to be found in the present unsatisfactory means of reaching the central part of Toronto from points on Yonge street adjacent to the city, it being necessary to transfer from the cars of the Metropolitan Street Railway to those of the city line, and also to pay an additional fare. It will be remembered that at the last session of the Ontario Legislature the Metropolitan Railway Company sought to obtain running rights over the Toronto Railway Company's track to the Union Station, but the application was refused for the reason that the two companies could not come to an agreement as to terms. Had such an arrangement been made, probably nothing would have been heard of the proposition to run a system of autocars. The interests of both railway companies and municipalities would, we believe, be best conserved by the appointment of a Board of Arbitrators to decide the question of running rights of one railway over the tracks of another, and to fix the rates of fares and matters of this character.

ELECTRICAL EXPOSITION IN 1898.

A COMPANY of New York gentlemen has been formed, with a capital of \$20,000, to conduct an electrical exhibition in that city some time during the present year, to follow the line of the show held in May, 1896, and which was a pronounced success. Mr. Marcus Nathan has been chosen as general manager. The new electrical inventions and improvements developed within the past two years will be an important factor, and it is hoped to greatly surpass the former effort.

The bill permitting the city of St. Thomas, Ont., to guarantee the bonds of the Electric Street Railway Company to the extent of \$50,000, has been passed by the Private Bills Committee of the Ontario Legislature.

MR. ALFRED T. SMITH.

PRESENTED herewith is the portrait of a gentleman well known in telephone circles, Mr. Alfred T. Smith, District Manager for the Bell Telephone Co., with headquarters at Kingston. Mr. Smith has just emerged from a serious illness, covering a period of more than two months. His friends will be glad to learn that although a month ago he was declared by the physicians to be beyond recovery, his excellent constitution enabled him to withstand the ravages of disease, and he is today out of danger and on the road to convalescence. A few weeks spent in a milder climate will, it is hoped, be the means of completely restoring him to health again.

Mr. Smith has been in the employ of the Bell Telephone Company for nearly twenty years, having entered their service at Hamilton in the year 1879, when 18 years of age. One year later found him in charge of construction, and the following year he built the first long distance telephone line in Canada, connecting the cities of Toronto and Hamilton. His ability and careful attention to business led to his appointment in January, 1882, as local agent for Peterborough and



MR. ALFRED T. SMITH.

Lindsay; from thence he was transferred to the Halifax agency in August, 1884. While in charge of this district the telephone system was installed on Sable Island much to the convenience and comfort of the guards. The electric light system of Halifax was also constructed under his immediate supervision. In 1886, at his own request, Mr. Smith was transferred to the Kingston agency, and in May, 1897, his faithful services were further recognized by his appointment as District Deputy of the Ontario Department. He is a brother of Mr. A. B. Smith, superintendent of construction for the G. N. W. Telegraph Company.

THE LATE WILLIAM BELL.

EARLY in December death removed ex-Alderman William Bell, Dominion government engineer, and possibly one of the best known men in Toronto. His illness was of a lingering nature, an attack of typhoid fever subsequently developing into jaundice. Deceased was 61 years of age. He was born in Woolwich, England, in 1836, and came to Canada when quite young. He settled first in Montreal, and came to Toronto in 1857, since which time he had gradually become a prominent figure in municipal and political life, serving as a member of the School Board and City Council.

For four years he held the position of tax collector. In 1890 the late Mr. Bell stood as an equal rights candidate in the provincial elections, but was unsuccessful. In 1894 his services were recognized by his appointment as government engineer at the Customs House in Toronto. Ever since 1854 Mr. Bell was connected with the Orange Lodge, having been County Master for two years. He was also a member of St. George's Masonic Lodge and of the Sons of England.

MUNICIPAL LIGHTING PLANT AT MAGOG, QUEBEC.

THE turning on of the power and light in connection with the new municipal lighting plant at Magog, Que., was made the occasion of a reception given by the mayor and councillors in the opera house. The hall was brilliantly lighted by many incandescent lamps, and the whole town turned out. Speeches were made by Mayor Bessette and other councillors, and a very pleasant evening was spent. Magog is one of the first towns in the eastern townships to adopt, own and operate its own lighting plant. The power is obtained from the Magog river, just below the cotton mills. The water wheel plant of the Crocker special type was furnished by the Jenckes Machine Company, of Sherbrooke, Que., and the generator, wiring and electrical plant by the Canadian General Electric Company.

The town have under consideration the control of the water works, with a view of locating a pumping station alongside the lighting plant, as plenty of power is available for this purpose.

BELL TELEPHONE COMPANY'S ASSESSMENT.

JUDGE Snider has given a written judgment in the assessment appeal of the Bell Telephone Company at Hamilton. The company was assessed for \$27,200 on land and buildings, \$24,700 on poles, wires, etc., \$5,000 income and \$21,600 personalty, on instruments, etc. The assessment on land and buildings was reduced to \$17,000, the income and personalty assessment was struck off, and the assessment on the poles, wires, etc., was reduced to \$13,940, the value of the poles, etc., in Ward 2. The judges held that the poles, wires and conduits were assessable as real estate, but the way the assessment was made they could only assess the poles, etc., in Ward 2. The judges held that the telephone instruments were personal property, and that under the act the company was not assessable for personalty. It was held that a reduction should be made for the cross-arms used by the city for fire alarm purposes, and that no agreement existed between the city and the company in reference to the assessment. The judges considered that the assessment should be made as a "going concern," and that the poles, etc., should be assessed up to 85 per cent. of the cost. While the assessment was reduced from \$78,500 to \$30,900, it is only \$2,200 less than last year. The judges decided in favor of the principle of assessing poles, etc., as real estate, and would have allowed the whole amount had the assessment been divided among the different Wards and not all in Ward 2.

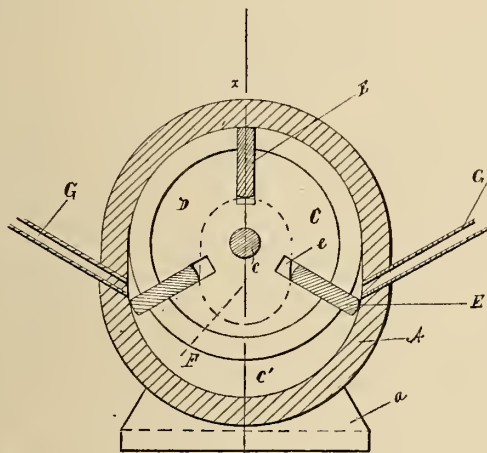
APPRECIATES IT HIGHLY.

MR. Roderick J. Parke, electrical engineer, Montreal, writes: "I am a regular subscriber to the ELECTRICAL NEWS, and appreciate it highly—in fact, I would not be without it for triple its cost."

RECENT CANADIAN PATENTS.

THE Patent Record contains descriptions of the following devices, for which patents have been granted in Canada :

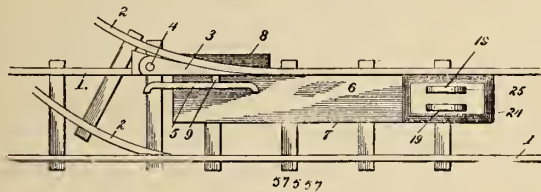
Steam engine indicator, Peter E. Apgar, Philadelphia, Pa.; smoke consumer, Chas. C. Bruckner, Chicago; apparatus for utilizing exhaust steam, Herman Ten Winkel, Denver, Col.; car brake for street railway, Patrick Flood, New York; gas engine, W. E. White and E. A. Myers, Garnett, Indiana; gas engine, Maxwell, Wyeth & Co., Brooklyn, N. Y.; motor vehicle, Charles H. Barrows, Williamantic, Conn.; apparatus for attaching electric lamp bulbs, Olney Smith, Detroit, Mich.; rotary engine, Charles A. Ingerham, Wabigoon, Ont.; smoke consumer, J. H. Saunders, Buffalo, N. Y.; meter, Canadian General Electric Co., Toronto; system of electrical transportation, Philip K. Stern, St. Louis, U. S.; system of electrical distribution, Canadian General Electric Co., Toronto; electric meter, Canadian General Electric Co., Toronto; motor reversing switch, Canadian General Electric Co., Toronto; grate for steam boilers, Alfred Davy and John Edey, London, Eng.; armature, Abe L. Cushman, Concord, U. S.; valve indicator, John T. Christie, Troy, N. Y.; storage battery, Lee & Co., Chicago; trolley wheel, R. I. McPhail, Toronto; system of electrical distribution, J. F. Kelly and C. C. Chesney, Pittsfield, Mass.; speed gear for motor cars, George G. Hardingham, London, Eng.; smoke consuming apparatus, Michel E. Bernier, Montreal; governor for steam engines, Edwin J. Armstrong, Oswego, N. Y.



ROTARY ENGINE.

Patentee: Walter F. Clements, Winnipeg, Man., granted 17th September, 1897.

Claim.—In a rotary engine, the combination with a cylinder eccentric in cross-section, of a revolvable piston bearing against one side of the cylinder and forming a steam chamber on the other side, said piston being provided with radial slots and recesses in its sides, stationary cams arranged inside the said recesses with their peripheries concentric with the periphery of the cylinder, and abutment plates slidable in the said radial slots between the said cams and cylinder, substantially as set forth.

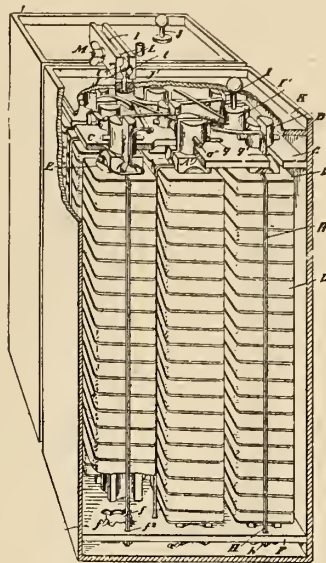


STREET RAILWAY SWITCH.

Patentee: Wm. A. Grant, assignee of Filmore Peters, both of Cornwall, Ont., granted 23rd September, 1897.

Claim.—In an automatic switch, the combination with an operating lever connected to a switch-tongue, of mechanism adapted to actuate the lever when operated by devices carried by a car. The combination of an operating lever arranged beneath the surface of the track, operating cams provided with bevelled surfaces, a friction-reducing device, and means for depressing the cams. An automatic switch comprising a box, a covering-plate therefor, an operating lever pivotted to the under side of said covering-plate and working within said box, said operating lever being suitably connected to a switch-tongue, an anti-friction roller carried by the operating lever, a series of operating cams pivotted adjacent to said lever and provided with bevelled surfaces adapted to contact with said anti-friction roller for shifting the lever, means for returning the cams to their normal position and

for assisting movement of the operating lever, in combination with a series of swinging arms carried by a car, a series of cam-levers also carried by the car, and suitable connections between said cam-levers and the swinging arms, the latter being adapted to contact with the operating cams for shifting the switch.



STORAGE BATTERY.

Patentee: Charles Riordon, assignee of Wm. J. Still, both of Toronto; granted 23rd October, 1897.

Claim.—In a storage battery, an electrode, comprising a rectangular, hollow spiral of flat strip sheet lead in flexible form with both edges free, an interposed hollow spiral of active material, exposed at the inside and outside, a rectangular supporting post for the electrode extending up through the spiral longitudinal grooves in each side of the post, and a lead from the centre edge of the spiral extending up through one of the grooves through the central opening of the spiral. The combination with the spirally formed electrodes, having the reduced top and bottom ends forming shoulders, of the top and bottom plates, slots in the same through which the leads extend, binding posts to which the leads are connected, and the top sealing plate resting on the tops of the posts and having openings through which the binding posts extend. The combination with the electrodes and leads therefrom, and binding posts to which the leads for each cell are connected, having stems with spherical heads, of a pair of connecting plates for the cells having arc-shaped grooves and clamping means for holding the spherical heads in the grooves, as and for the purpose specified.

PERSONAL.

At a meeting of the board of directors of the Niagara Falls Park and River Railway, held in Toronto, Mr. Wilfred Phillips, who had completed his first year as acting manager of the road, was appointed general manager.

Prof. Alexander Melville Bell, of New York, the distinguished scientist and father of Mr. Graham Bell, the inventor of the telephone, has chosen a Canadian lady as a partner in life, in the person of Mrs. H. G. Shibley, of Harrowsmith, Ont.

Mr. R. C. Pettigrew, of Hamilton, treasurer of the Executive Council of the Canadian Association of Stationary Engineers, was elected alderman for the Seventh Ward at the municipal elections this month. Mr. Pettigrew was formerly a member of the School Board.

Mr. T. R. Rosebrugh, lecturer in electrical engineering at the School of Practical Science, Toronto, was married on the 30th of December last, at Syracuse, N. Y., to Miss Jessie Aeolia Whyborn, only daughter of Dr. Whyborn, of that city, the ceremony being performed by Rev. R. Calthrop. The ELECTRICAL NEWS joins with the many friends of the bride and groom in wishing them many years of wedded happiness.

Mr. Walter Rogers, brother of Mr. Joseph Rogers, of the Rogers Electric Company, died at St. Joseph's Hospital in London last month, after an illness of a couple of months. Deceased was an electrical construction man of wide experience and exceptional ability. Before going into business with his brother he spent two years at electrical work in Vancouver, B. C., for the Vancouver Street Railway, and one year in Chicago with the Edison Electrical Construction Company.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

NOTE.—Secretaries of Associations are requested to forward matter for publication in this Department not later than the 28th of each month.

TORONTO NO. 1.

At a meeting of Toronto No. 1, held on December 15th, there was a large attendance. The trustees of the hall reported that the Queen City Insurance Company had allowed the sum of \$154.71 for damages occasioned by the recent fire, which will nearly cover the loss. A letter was read from Mr. J. J. Main, regretting his inability, owing to business engagements, to deliver a promised lecture. He hoped to be able to favor the association at a later date. Mr. Milne worked out some problems in electricity. Over fifty members were present at the regular meeting on January 5th. There was one initiation and four propositions for membership. The association was notified that the new association started in the west end of the city would hold a formal opening on Thursday evening, January 13th, to which all the members of No. 1 were invited. A committee was appointed to arrange for an At-Home to celebrate the re-opening of the hall. On Tuesday, the 11th inst., an open meeting was held, at which Mr. James Milne, manager of the Weeks-Eldred Company, delivered an interesting lecture. The regular meetings are held on the first and second Wednesdays of each month, and the president especially requests a large attendance during the winter months.

HAMILTON NO. 2.

THE above association is keeping up its standard in educational work. At a recent meeting Mr. A. M. Wickens, of Toronto No. 1, read a paper on Latent Heat, and at a later meeting a paper was presented by Mr. F. G. Mitchell, which will be found on another page.

QUESTIONS AND ANSWERS.

A CORRESPONDENT sends the following as a partial answer to "Amateur" in the December issue of the NEWS:

Absolutely correct results cannot be obtained from the diagrams, for the reasons (1) that they are not full size, and (2) they are not all to the same reduced scale. The results given below, however, will be correct for all practical purposes. In taking pipe diagrams, care should be taken to have them the same length as the others taken from the engine. When this is the case the proportions between them are exact, and when not the case the proportions must be determined by calculation. For convenience let us number the diagrams 1, 2, 3 up to 9, where 1 is the first set of exhaust cards. In comparing 1 and 3 there is a difference of 5-16 inch in their lengths, and between the first and last cards of No. 1 set there is a difference, showing that the cord must have been stretching.

We do not know exactly what is required in the nature of calculation of the exhaust cards, whether "Amateur" means to determine the point of release, etc., in terms of the stroke, or whether he desires the amount of horse power the engine exerts in working against the back pressure. We are inclined to think it is the latter, and if so this must be calculated from the other diagrams. In diagrams 3, 4, 5 and 6 we have respectively mean forward pressures of 19.6, 44, 15.4, 23 lbs., and mean backward pressures of 11.9, 9, 11.2,

9.7 lbs. respectively, giving us mean effective pressures of 7.7, 35, 4.2, 13.3 lbs., which, when calculated, gives forward horse powers of 24.6, 54, 19.3, 28.6, backward horse powers of 14.93, 11, 14, 12; the difference between the two being the resultants or indicated horse powers, which are 9.67, 43, 5.2, 16.6 respectively. It is not customary to calculate the gross forward and backward h.p., it being far easier to get the net or i h. p. directly from the diagrams. The M.E.P. of diagrams 7, 8 and 9 are 3.9, 9.1 and 3.2 lbs., and the indicated horse powers are 7, 16.2, 56 respectively.

In the exhaust diagrams, No. 1, when measured to scale, we find that release takes place when piston is about $2\frac{3}{4}$ inches from head end of stroke and $3\frac{3}{4}$ inches from crank end. Compression commences about half-stroke.

From the above "Amateur" can draw his own conclusions regarding straight and centre connections. Probably some of the rest of your readers will answer whatever else is necessary.

M. J.

A NEW DETERMINATION OF THE VALUE OF THE OHM.

WITH the aim of obtaining a standard value of the unit of resistance, which value should not change with time, the machine known as the Lorenz apparatus has been developed. The British Government has adopted a standard known as the "Board of Trade Ohm Standard, Verified, 1894," which is a purely physical standard, the constancy of which, with time, depends on the assumed absence of any changes in its molecular structure or physical strains. The Lorenz apparatus, says the Electrical World, depends upon the demonstration by the dimensional system, that a resistance is proportional to a velocity, and hence can be measured by standards purely of length and time, which are less likely to change in centuries to come than the physical aggregation of the molecules of any standard resistance.

The Lorenz apparatus, as built by Messrs. Nalder Bros., of London, for the McGill University, of Montreal, consists of a bronze disc, mounted centrally on a shaft, by which it can be rotated in its own plane at high speeds, and concentric with this disc a solenoid surface in a helical groove of semi-circular section cut in the cylindrical surface of a massive marble ring. The ring is about 21 inches outside diameter, 15 inches inside diameter, and 7 inches in axial length.

The determination of the ohm involves the exact calculation of the co-efficient of mutual induction between this coil and the periphery of the disc, and therefore involves the exact measurement of the diameter of the coil and disc. This was done with a Whitworth measuring machine, a long series of observations in different directions giving a highly accurate result. To prevent any leakage of current from turn to turn, double silk-covered wire was used, brushed over with melted paraffin wax. The co-efficient of linear expansion of the marble was also determined. The phosphor-bronze disc was ground in place, so as to be made true on its axis of rotation, and its diameter and co-efficient of linear expansion were carefully measured.

Contact was made with the centre of the disc by a tube projecting into an axial hole in the disc and carrying a small stream of mercury. Three small tangential phosphor-bronze tubes were pressed lightly against the

periphery of the disc at three points, separated by an angular distance of 120°. Mercury was passed through these tubes also, the effect being to greatly diminish the disturbances due to thermo-electric effects.

The method of determining the resistance was a zero method, the current in the field coil being passed through the resistance to be determined; and the E.M.F. set up in the disc at the proper speed, being balanced against the fall of potential in this resistance. For balancing an extremely sensitive Ayrtton-Mather galvanometer of the d'Arsonval type was used. Extreme care was taken in the preparation of the resistance coils, their comparison with the Board of Trade standard, and the determination of their temperature co-efficients. The thermometers used in the investigation were carefully calibrated at Kew, and the clock which was used for the determination of the speed was compared with the time set from Greenwich.

The results of the successive measurements of the absolute resistances became very concordant after various possible causes of small errors had been gradually eliminated. Nine sets of observations taken on July 30, 1897, gave results for the value of the Board of Trade ohm in true ohms, which showed, when all corrections had been made, that one Board of Trade ohm = 1.00026 true ohms.

This result was then discussed in the light of all sources of error that could enter into it, and the effects that would be produced by such errors. The marble ring and the phosphor bronze disc were carefully tested in induction balances for the presence of possible traces of iron which would affect their permeability, no such effect being detectable with a sensitiveness to one part in 15,000. The final conclusion of the series of tests was that the Board of Trade ohm is between two and three parts in 10,000 larger than the true ohm. This is probably the most precise comparison of physical standards of resistance with their defined value ever made.

MOONLIGHT SCHEDULE FOR FEBRUARY.

Day of Month.	Light.	Extinguish.	No. of Hours.
	H. M.	H. M.	H. M.
1....	A.M. 2.40	A.M. 6.40	4.00
2....	" 3.30	" 6.40	3.10
3....	" 4.00	" 6.40	2.40
4....	No Light.	No Light.	.....
5....	No Light.	No Light.	.....
6....	No Light.	No Light.	.....
7....	No Light.	No Light.	.....
8....	P.M. 6.00	P.M. 9.40	3.40
9....	" 6.00	" 9.50	3.50
10....	" 6.00	" 11.00	5.00
11....	" 6.00	A.M. 12.10	6.10
12....	" 6.00	" 1.20	7.20
13....	" 6.00	" 2.30	8.30
14....	" 6.00	" 3.40	9.40
15....	" 6.00	" 4.50	10.50
16....	" 6.10	" 5.50	11.40
17....	" 6.10	" 5.50	11.40
18....	" 6.10	" 5.50	11.40
19....	" 6.10	" 5.50	11.40
20....	" 6.10	" 5.50	11.40
21....	" 6.10	" 5.50	11.40
22....	" 6.10	" 5.50	11.40
23....	" 8.10	" 5.50	9.40
24....	" 9.20	" 5.50	8.30
25....	" 10.20	" 5.50	7.30
26....	" 11.00	" 5.50	6.50
27....	" 11.20	" 5.50	6.30
28....	" 11.50	" 5.50	6.00

Total..... 191.30

SPARKS.

The London Electric Light Company have erected a small addition to their building.

Leonard & Son, of Dundas, Ont., have purchased an incandescent lighting plant from the Canadian General Electric Co.

The Danville Electric Light Co. have purchased a 60 kilowatt single phase alternator from the Canadian General Electric Co.

The Canadian General Electric Company are installing an isolated plant for R. F. Hicks, of Norwich, Ont.

The corporation of Magog, Que., have placed an order with the Canadian General Electric Company for a 2,000 light alternator of their single phase, revolving armature compound type.

The Richmond Light and Power Co., of Richmond, Que., are adding to their electric lighting equipment, and have placed with the Royal Electric Co., Montreal, an order for one of their 75 k.w. "S.K.C." generators and switchboard apparatus complete.

The Toronto Railway Co. have given an order to the Canadian General Electric Co. for an 850 kilowatt direct-connected generator. This machine will be a duplicate of that which has been in operation in their power house for two years past.

Messrs. Edgar & Roy, of North Hatley, Que., are at present enlarging their electric lighting plant, and propose to furnish power as well as light in the future. In order to be in a position to do this they have placed their order with the Royal Electric Co. for a 60 k.w. "S.K.C." two-phase generator, which will be installed immediately.

The Dechenes Electric Company are lighting the Russell House and Opera House in Ottawa. They have recently placed an order for several induction motors with the Canadian General Electric Company, to be operated from their monocyclic circuits.

The Edmonton Electric Light Co., of Edmonton, N.W.T., are improving and extending their plant. The new electrical equipment purchased by them from the Royal Electric Company consists of one 75 k.w. "S.K.C." two-phase generator, complete, with exciter and switch-board, as well as the necessary material for the other changes.

At the last meeting of the town council of Granby, Que., the question of a more complete and efficient electric light system was considered. It was moved that the secretary be authorized to advertise for tenders for an arc and incandescent plant, but at the suggestion of Mayor Miner the motion was allowed to stand pending definite information in regard to the tannery water power.

The new 100 arc light plant at Chatham, Ont., has been taken over from the contractors by the city, and is said to be running satisfactorily. The electrical apparatus, including dynamos, lamps and circuits, was furnished by the Thompson Electric Company, of Hamilton. In a later issue we hope to present an illustrated description of this plant, which is one of the largest yet to be installed in Canada under civic control.

The contract for the power transmission plant of the British Columbia Railways Company at Victoria, B.C., reference to which has already been made in this journal, has been awarded to the Canadian General Electric Company, and will consist of three-phase generators adapted for direct connection to Pelton water wheels, having an aggregate capacity of 1,500 horse power.

For the past two years a philanthropic association of Montreal, the St. Jean Baptiste Society, has organized a series of free lectures in their edifice, the Monument National. This year a series of lectures on "Practical Electricity" has been added to the programme, the lecturer being Mr. Louis A. Herdt, E.E., Consulting Engineer and Lecturer in Electrical Engineering at McGill University. These lectures were begun in October last, and are exceedingly well attended, over 200 people, young and old, in search of learning, having availed themselves of the opportunity thus afforded.

The Toronto branch of the Bell Telephone Company have issued to subscribers an improved telephone directory, which in point of convenience and general arrangement is especially worthy of mention. The book is well printed, and the absence of advertisements throughout the pages is a noticeable improvement. A complete list of the offices in Ontario and Quebec connected with the long distance lines appears in the front, while a numerical list of the telephones of the Toronto exchange, showing in the order of their numbers the page in telephone directory on which any number may be found, is also included.

The town of Parrsboro, N. S., is installing a complete arc and incandescent system, and has awarded contracts for apparatus as follows: Complete steam plant, including Monarch Economic boiler and two engines, Robb Engineering Co., Amherst, N. S.; arc dynamo and lamps, Thompson Electric Co., Hamilton; alternating generator, Munderloh & Co., Montreal, as agents for the Warren induction type; transformers, W. A. Johnson Electric Co., Toronto; lamps and meters, Packard Electric Co., St. Catharines; supplies, Canadian General Electric Co., Toronto. The plant is expected to be in operation by February 1st. Mr. Geo. White-Fraser, of Toronto, is consulting engineer.

EDUCATIONAL DEPARTMENT

INTRODUCTORY

After mature deliberation the publisher of this journal has decided to devote a certain amount of space each month to what may be termed an Educational Department, wherein both mechanical and electrical formula and mathematical problems will be discussed, illustrated, and as far as possible rule and example given. At the request of the editor, I have with pleasure undertaken to contribute to this department regularly each month, and before discussing actual mathematical problems, wish to briefly introduce the subject at issue.

The primary object of this department is chiefly to increase the value of an already valuable paper, by placing in the hands of every engineer who has any knowledge of the rudimentary principles of mathematics, such matter as will enable him by a little study to master the most intricate mechanical and electrical formula. Many of our most valuable engineering works and publications from time to time contain formula that is in many cases but vaguely understood, and very often entirely misunderstood, thus rendering an otherwise valuable work practically valueless to the reader.

Just at what particular point our calculations should commence became a matter of serious thought, and past experience had to be carefully considered, bearing in mind the fact that there are many really good engineers whose early education has, through force of circumstances, been deficient, and many others who, through lack of opportunity, have not been able to review their early education for years. Knowing by observation and experience the great necessity of having a thorough elementary education before attempting to digest and calculate problems, and the almost utter impossibility of the student arriving at a satisfactory conclusion of his studies without a thorough knowledge of the principle of mathematics involved, I have decided to commence at a point and carry out the programme outlined in this journal—commencing at the foundation and advancing by easy stages until the principles underlying the most obtuse and difficult formula can be readily explained and easily understood. The advantages to be derived from an education of this kind, coupled with practical mechanical ability, is too well understood to require comment.

The programme which has been outlined for the succeeding nine months will embrace:

DECIMAL FRACTIONS—Definitions and explanation of principles of, and method of reduction to common fractions, and vice versa.

SQUARE AND CIRCULAR MEASURE—Definition and explanation and practical demonstrations of.

CUBICAL AND CYLINDRICAL MEASUREMENTS—Definitions and explanations of, with practical hints.

SQUARE AND CUBE ROOT—Definitions and explanations of.

SAFETY VALVE CALCULATIONS—(Spring and Lever Types)—Principles of, with practical demonstrations.

BOILER CONSTRUCTION—Stays, rivets, joints and seams, iron and steel plate—strength of, with formula and practical demonstrations.

It is not the intention to fill these columns with a mass of figures hastily compiled without reference to any particular object; on the contrary, every problem will be carefully thought out, and only such information given as will be of use to you, and an effort will be made, based on experience and a knowledge of the requirements, to make his series of tests complete in every particular.

WM. THOMPSON.

[ARTICLE IX.]

DIVIDED AND SHUNT CIRCUITS.

A conductor from one terminal of a generator may be divided into any number of divisions or branches. Each branch or division may vary in resistance, and they may all unite on reaching the other terminal.

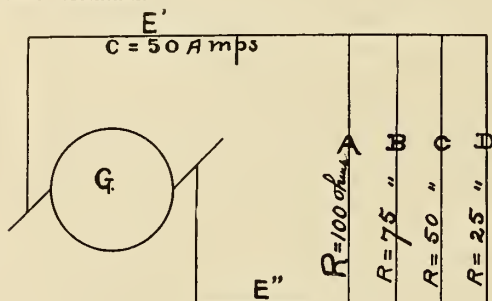


FIG. 2.

Example 6: A portion of the circuit connected with generator G in Fig. 2 consists of 4 parallel conductors, A, B, C and D. R of A=100 ohms; B=75 ohms; C=50 ohms, and D=25 ohms, what will be the ratio of current passing through the circuit which will pass through each conductor.

According to Rule 1 the current passing through each of the conductors A, B, C and D will be inversely proportionate to its resistance.

$$\therefore \text{As } A : B : C : D :: \frac{1}{100} : \frac{1}{75} : \frac{1}{50} : \frac{1}{25}$$

Or to simplify:

$$\begin{aligned} \text{As } A : D &:: 100 : 25 \\ B : D &:: 75 : 25 \\ C : D &:: 50 : 25 \end{aligned}$$

That is, that the ratio which current passing through conductor A bears to current passing through conductor D is the same as the ratio that the resistance of conductor A bears to R of conductor D, and so on for all the other conductors.

Example 7: Supposing the current passing through terminals of generator, and consequently through circuit, to be 50 amperes, what amount of current will pass through each of the branches, A, B, C and D, in foregoing problem.

To determine the amount of current that will pass through parallel circuits of different resistances, take the resistance of each branch in ohms as a denominator, having 1 as a numerator. Reduce the fractions to a common denominator and add together the new numerators. Take the sum of the numerators as a new common denominator, and the single numerators as new numerators, and new fractions will express proportional currents passing through portions of circuit as units of one.

$$\text{Then } \frac{1}{100} \frac{1}{75} \frac{1}{50} \frac{1}{25} \frac{3 \cdot 4 \cdot 6 \cdot 12}{300}$$

And sum of numerators equals 25, using this as per rule $\frac{3 \cdot 4 \cdot 6 \cdot 12}{25}$

$\therefore$ current passing through branches expressed in units of one must equal: $A = \frac{3}{25}$; $B = \frac{4}{25}$; $C = \frac{6}{25}$; $D = \frac{12}{25}$.

Total current passing through circuit is given as 50 amperes.

$$\begin{aligned} \text{Then current passing through } A &= \frac{3}{25} \times 50 = 6 \text{ amp.} \\ \text{“ “ “ “ } B &= \frac{4}{25} \times 50 = 8 \text{ amp.} \\ \text{“ “ “ “ } C &= \frac{6}{25} \times 50 = 12 \text{ amp.} \\ \text{“ “ “ “ } D &= \frac{12}{25} \times 50 = 24 \text{ amp.} \end{aligned}$$

It will be observed in Fig. 2 that current passing through cir-

cuit first passes through conductor E', and when parallel branches are reached four paths are provided for its passage, when it again unites on conductor E''.

It is quite evident that the more paths there are provided for the passage of the current the less resistance will be offered. This brings up a problem as to resistance offered by the parallel branches of a circuit as compared with a single conductor.

It is quite clear that we cannot summarize or add the resistances of each parallel branch together. If branch A had only been provided, then resistance of A would have been the resistance of that portion of the line, but addition of other branches clearly reduces resistance of each branch to flow of current by providing another path for its passage.

In divided circuits the resistance of the combined branches is expressed by the reciprocal of the sum of the reciprocals of the resistances.

Example 8: Find the resistance of the combined branches, A, B, C and D, as set forth in foregoing examples.

The reciprocal of resistance is conductance expressed usually as Mhos, a derivate of the word Ohms.

The reciprocal or conductance of the four branches then is:

$$\frac{1}{100} + \frac{1}{75} + \frac{1}{50} + \frac{1}{25} = \frac{6}{600} \text{ or } \frac{1}{100} \text{ Mhos.}$$

The resistance of the combined branches is as $5 : 60 = 12$ ohms.

Application of Rule 3 to this problem proves that the E M F on each of branches is equal 600 volts.

$$\begin{aligned} \text{R of A} &= 100 \text{ ohms and C} = 6 \text{ amps. E M F } 600 \text{ volts.} \\ \text{R of B} &= 75 \text{ “ “ “ “ “ “ “ “ “ “ } 8 \text{ “ “ “ “ “ “ } 600 \text{ “} \\ \text{R of C} &= 50 \text{ “ “ “ “ “ “ “ “ “ “ } 12 \text{ “ “ “ “ “ “ } 600 \text{ “} \\ \text{R of D} &= 25 \text{ “ “ “ “ “ “ “ “ “ “ } 24 \text{ “ “ “ “ “ “ } 600 \text{ “} \end{aligned}$$

And combined resistance of A, B, C, D=12 ohms combined. C=50 amps. E M F 600 volts.

Perhaps a clearer method of arriving at the combined resistance of parallel circuits is to use the formula

$$R = \frac{R \times R^1}{R + R^1}$$

Which is based on the principle that the combined resistance of two parallel circuits can be found by multiplying their resistances together and dividing the product by the sum of their resistance.

By this method, combining A and B we get $\frac{100 \times 75}{100 + 75} = 42.8$ ohms.

Combining C and D we get $\frac{50 \times 25}{50 + 25} = 16.7$ ohms.

Then combining these two products we get $\frac{42.8 \times 16.7}{42.8 + 16.7} = 12$ ohms combined R of branches A, B, C and D.

If the whole of the branch circuits were of uniform resistance, then formula could be very much simplified by using formula

$$R = \frac{R}{N}$$

When the resistance of one branch is divided by the number of branches the quotient will be the combined resistance of all the branches.

Example 9: What would be the combined resistance of four parallel branches each having a resistance of 100 ohms?

$$\frac{100}{4} = 25 \text{ ohms.}$$

STRENGTH OF STAYS AND FLAT SURFACES.

We require here to find area and number of stays required, area of surface supported by one stay, and the pressure that may be allowed against any flat surface.

The greatest stress per square inch of section of an iron stay

allowed is 6000 lbs. Then calling this the T. S. (tensile strength) of our formula, the total stress on a stay may be found by the following formula :

$$\text{Stress (S)} = a \times T \times S$$

Example : Find the stress allowable on a direct stay $1\frac{1}{4}$ inches in diameter when the stress allowable equals 6000 pounds per square inch section.

$$S = a \times T \times S = 1.25^2 \times .7854 = 1.2271 \text{ square inches of section.}$$

$$1.2271 \times 6000 = 7362.6 \text{ total stress allowable on stay.}$$

Example, the stays of a boiler are $1\frac{1}{4}$ " in diameter and placed 12 inches apart, what should be the working pressure of the boiler if the stress allowable per square inch section of stay is 6000 pounds.

Rule: First find the stress the stay is capable of supporting, then divide the result by the area held up by each stay and the quotient with the pressure allowable on the boiler.

$$1.25^2 \times .7854 = 1.2271 \text{ square inches section of stay.}$$

$$1.2271 \times 6000 = 7362.6 \text{ total stress allowable on stay.}$$

Since the stays are 12 inches apart or 12 inches from centre to centre of stay, each stay must support a section of plate equal to 12 inches squared.

Then $12 \times 12 = 144$ square inches area, supported by each stay. Then $7362 \div 144 = 51.1$ pounds pressure allowable on the boiler.

Rule to find required diameter of stay : Area of section in square inches held up by each stay multiplied by pressure on boiler divided by stress allowable per sectional inch on stay equals required area of stay.

$$\sqrt{\text{area} \div .7854} = \text{diameter.}$$

Example : Find the required diameter of a direct stay when allowable stress on stay is 6000 pounds per square inch of section and stays are 15 inches apart with boiler pressure at 75 pounds per square inch.

$$15 \times 15 = 225 \text{ square inches of surface supported by stay.}$$

$$225 \times 75 = 16,875 \text{ pounds stress on each stay.}$$

$$16,875 \div 6000 = 2.81 \text{ square inches required area of stay.}$$

$$\sqrt{2.81 \div .7854} = 1.9 \text{ diameter of stay required.}$$

Example: the stays of a boiler are $1\frac{1}{2}$ inches in diameter and capable of sustaining a stress of 8,835 pounds, what distance must they be pitched apart to sustain a working pressure of 60 pounds to the square inch?

Rule: $\frac{8835}{60} = \text{area of section, and square root of area of section equals pitch or distance from centre to centre of stays.}$

$8835 \div 60 = 147.2$ area of section to be supported in square inches. $\sqrt{147} = 12.125$ length of each side of section of plate, or required pitch of stay = $12\frac{1}{8}$ inches.

$$\text{Proof: } 12.125^2 \times 60 = 8,820.$$

[Note.—This result would have been exact had fractional parts of an inch been worked out.]

We now have rules for three of the most important determinations relating to stays :

1st. Determining the total weight or stress that a stay is capable of supporting.

2nd. Determining the required diameter of a stay when total weight to be sustained is known.

3rd. Determining the area of surface a stay of given dimensions is capable of supporting under known conditions.

To practical operating engineers these questions are of great importance; I will therefore repeat the examples under conditions which they may be expected to be met with in ordinary practice.

Example : The stays on a flat surface are 12 inches apart centre to centre, and through corrosion, have eaten away to 1 inch in diameter. The pressure per square inch on the boiler is 60 pounds, what is the strain per square inch section of stay, and to what pressure should the strain be reduced to give a stress of 5,000 pounds per square inch section of stay.

$$12 \times 12 = 144 \text{ square inches held up by each stay.}$$

$$144 \times 60 = 8640 \text{ pounds held up by each stay.}$$

$$1^2 \times .7854 = .7854 \text{ square inches sectional area of stay.}$$

Then stress per square inch section of stay equals :

$$8640 \div .7854 = 11,000$$

This is clearly sufficient to break the stay and render the boiler unsafe.

$5000 \times .7854 = 3927$ pounds weight that stay is capable of sustaining.

$$3927 \div 144 = 27.27 \text{ pounds safe working pressure.}$$

And therefore to comply with conditions named that strain on stay must not exceed 5000 pounds per square inch of section, boiler pressure must not be allowed to exceed 27.27 pounds per square inch.

Example : The stays of a boiler are 10 inches apart, and one of

them breaks, throwing more stress on the four surrounding stays. The stays are $1\frac{1}{8}$ inch in diameter, and the boiler pressure is 50 pounds per square inch, what extra stress will be placed per square inch of section of stays if area supported by each has been increased by $\frac{1}{3}$, and what must the boiler pressure be reduced to so that stress per square inch section of stay shall not exceed original stress.

Stress held by each stay equals—

$$10 \times 10 = 100 \times 50 = 5000 \text{ pounds.}$$

Sectional area of stay equals—

$$1.125 \times 1.125 \times .7854 = .994 \text{ square inches, stress per square inch of section before the break} = 5000 \div .994 = 5030 \text{ pounds.}$$

Then stress per square inch of section after the break =

$$5030 + \frac{1}{3} \text{ of } 5030, \text{ or } 5030 + 1676.66 = 6706.66 \text{ pounds.}$$

Stays before break supported $10 \times 10 = 100$ square inches of surface, and after the break they are called upon to support $\frac{1}{3}$ more, or 133.33 square inches.

Original stress per square inch section of stay = $5030 \div 133.33 = 37.7$ pounds per square inch, to which point pressure must be reduced so that original stress on stays may be maintained.

Example : What is the total pressure on the flat bottom of a boiler 18 feet 6 inches long by 6 feet wide, the pressure of the steam being 30 pounds per square inch, and the depth of water 10 feet 5 inches. Find also the required number of stays $1\frac{1}{2}$ inches in diameter, and what diameter they must be pitched apart when the stress per square inch of section of stay shall not exceed 6000 pounds.

Take a column of water 1 foot high and 1 square inch in area as weighing .434 pounds.

$$10 \text{ feet } 5 \text{ inches equals } 10.416 \text{ feet.}$$

$\therefore 10.416 \times .434 = 4.51$ pounds pressure per square inch through weight of water.

Then $4.51 + 30 = 34.51$ total pressure per square inch on bottom of boiler. The boiler is $18' 6"$ by $6' = 18.5 \times 6 = 111 \text{ sq. feet area.}$

$$113 \times 144 = 16272 \text{ area of boiler in square inches.}$$

$16272 \times 34.51 = 561,546.72$ pounds total weight bottom of boiler is called upon to support.

Area of stay equals $1.5^2 \times .7854 = 1.767$ square inches.

$1.767 \times 6000 = 10602$ pounds weight that one stay is capable of holding up.

$$561,546.72 \div 10602 = 53 \text{ nearly number of stays required.}$$

Or we might say since each stay is capable of supporting 10602 pounds, $10602 \div 34.51 = 307$ square inches area of plate each stay can support.

$$16272 \text{ total area of boiler } \div 307 = 53 \text{ number of stays required.}$$

$$\sqrt{307} = 17.5214 \text{ inches distance from centre to centre of stay.}$$

The Acetylene Lighting Company has been formed at London, Ont., to manufacture apparatus for the production of acetylene gas.

The Canadian General Electric Company are supplying a 1,000 light direct-connected, incandescent lighting plant to the Gutta Percha & Rubber Mfg. Co. This installation will be, when finished, one of the most complete in the country. The machine is of the steel frame, ventilated armature type, direct-connected to an "Ideal" engine, running at the slow speed of 280 revolutions per minute. The great saving in space, durability and high efficiency, obtained by the use of these direct-connected units, has led to their almost exclusive adoption as the standard machine where it is desired to obtain the best and most economical conditions in operating an isolated incandescent lighting plant.

The Colonial Lighting Syndicate is said to be endeavoring to secure control of electric light, gas and street railway systems in Ontario. A recent issue of the Belleville Intelligencer says: The proprietor of this paper has been in regular communication for many months with a Toronto firm acting in the syndicate's interests, and we are given to understand that if the negotiations go through, it is the intention of the syndicate to extend the road to Tweed, using heavy rails that will enable the C. P. R. to haul their cars to and from that village, a contract for that purpose to be entered into with the railway company. We also understand that Sir William Van Horne has agreed to give a certain sum of money towards the enterprise. The street railway is also to be run to Trenton. The object of the syndicate is to secure a number of similar enterprises in Canada, operating these under one system, which it is now doing in Ceylon, where the representative now in Canada has been for twelve years.

ELECTRIC RAILWAY DEPARTMENT.

THE WEST INDIA ELECTRIC COMPANY.

REFERENCE has been made in previous issues of this journal to the formation of a company, composed chiefly of Canadian capitalists, to build an electric railway at Kingston, Jamaica. The directors of the company, which will be known as the West India Electric Company, Limited, are: F. S. Pearson, of New York; Hon. Senator L. J. Forget, W. B. Chapman, William McLennan and C. E. L. Porteous, of Montreal, and E. A. Haggart, of Jamaica, the latter representing the Board in the island. Some of these gentlemen have just returned from Jamaica to Montreal, and report the undertaking as progressing favorably. The old street car system has been taken over and contracts awarded for the building of the new road, which will be about twenty-five miles in length, with possible extensions, and will cost in the vicinity of half a million dollars. It is also probable that electric lighting will be taken up.

Recently the new directors reduced the fares one-half, and the first day's earnings are said to have shown an increase of 30 per cent.

The company are fortunate in having secured as their



MR. HENRY HOLGATE, C.E.
Manager West India Electric Company.

manager Mr. Henry Holgate, in whom for nearly three years has been vested the management of the Montreal Park and Island Railway. Mr. Holgate was born at Milton, Ont., in the year 1863. After serving his apprenticeship in railway work, he became chief engineer of the combined Northern and Great Northern Railways, which were merged into the Grand Trunk in February, 1888. Four years later he resigned to accept a position as engineer with the Central Bridge and Engineering Company, of Peterboro', and in June, 1894, removed to Montreal and became engineer for the Royal Electric Company, superintending the building of their new factory. At that time the directors of the Royal Electric Company were interested in the Montreal Park and Island Railway, and Mr. Holgate was transferred to the management of this road in June, 1895, in which capacity he has since continued.

Mr. Holgate's extended railway and general engineering experience should prove of great benefit to him in his new field. We are pleased to present his portrait herewith.

LEGAL.

LONDON STREET RAILWAY CO. VS. CITY OF LONDON.—The Board of Judges rendered their decision last month in the appeal case of the London Street Railway Company against an assessment on rails, poles, wires and cars, the judgment upholding the assessment. In order to simplify matters, the appeal was argued in two sections: 1st, against the assessment of \$80,000 on rails, poles and wires as real estate; and 2nd, against the assessment of \$50,000 on the cars as personal chattels of the company. Judge Hughes and Judge Elliott entirely agreed in upholding the Court of Revision in both instances, Judge Finkle holding the cars to be non-assessable. Judge Hughes, in his judgment, pointed out that the statutes under which the company operated curtailed the common-law right of the public to the use of the road by giving an exclusive occupancy for the time being of their cars, rails, poles, wires, etc. He therefore held that it was the public and not the company which enjoyed merely an easement of the street, and quoted Chancellor Rose's decision in the case of the Consumers' Gas Co. vs. Toronto, in support of this contention. This decision of the Supreme Court, he thought, exhausted everything that could well be said on the subject, and settled the law in the main features of the present case. His judgment in part was as follows: "I therefore think the appellants, as respects this subject of appeal, must be dismissed, and the decision of the Court of Revision in respect thereof upheld and affirmed, with costs to be paid by the appellants of the company. As to the cost of construction, I must believe that there was no real intention of placing a separate or enhanced tax upon the costs; of placing the other subject of assessment, i.e., realty, beyond what they are worth if so placed, for I cannot understand that if in the valuation of this property the assessment commissioner or the Court of Revision ever intended to place a tax upon property beyond the intrinsic value when assessed. How, for instance, can a bridge be assessed at the value of the cost of its construction supposing the contractor who built it received a great deal more or a great deal less than it is worth, or because he so slighted his work that it is not nearly so safe or efficient for the purposes that it was intended or contracted for? In respect to the assessment of the cars of the appellants' company, I regard them as movable chattels, which are not attached to the freehold or the wires, poles, or machinery of the railway, much less the rails upon which they are propelled. The propelling power, electricity, by no means fastens them to the freehold. . . . And therefore, in the absence of proof which would bring the chattels of the railway company within some one of the exceptions provided by the Assessment Act, that they are otherwise assessable, I would uphold and affirm the Court of Revision in respect thereof, and dismiss the appeal on all parts with costs to be paid by the company." In his judgment, Judge Elliott recited at length the contentions, and asked if there was any substantial difference between gas pipes and rails on the street with regard to the occupancy of the soil. The decision of the Supreme Court in the case of the Consumers' Company vs. Toronto held that there was not. The judge went on to quote extensively to show that there was no reasonable distinction between the two cases, and wound up the first part with the brief line: "I therefore conclude that the objection is not tenable." Regarding the second point, the judge held that the cars differed from the rails, poles and wires, which if separated from the main building would render the whole inoperative, and he went on to say, and therefore thought the cars assessable as personalty at \$50,000. Judge Finkle also held that the case of the Consumers' Gas Company was not distinguishable from the case in point, and gave judgment accordingly. "As to the cars," said he, "I am unable to satisfy myself that the cars are really. . . . I feel that the cars are not a class of property liable to assessment, and decline to ratify the assessment of the Court of Revision, and direct that the assessment as to street cars shall be stricken out, and that the costs in this particular class shall be paid by the city of London."

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SPARKS.

John Campbell, of St. Thomas, Ont., is installing a 100-light dynamo in his mill.

The telephone cable between Quebec and Levis was carried away by the ice recently.

The Canadian General Electric Company have installed an isolated plant for Messrs. A. & J. Clarke, Bullocks Corners, Ont.

The village of Huntingdon, Que., has purchased the electric light plant from the Stadacona Water, Light & Power Company.

Manager Leather, of the Hamilton Radial Electric Railway, says the line will be extended to Bronte by May 1. The road has been built into Burlington.

The British Columbia Iron Works Company, of Vancouver, have placed an order for a 10-kilowatt, direct connected, steel frame, incandescent lighting generator with the Canadian General Electric Company.

The Shipton Electric Co., of Danville, Que., have decided to proceed with the extension of their power plant this winter, and have made a contract with the Jenckes Machine Co., of Sherbrooke, for one of their Crocker turbines, horizontally set, with penstock and draft tube complete.

The proposition to build an electric railway from Amherstburg to Windsor came up at a recent meeting of the Amherstburg Council. It was stated that a Mr. Jacobson was willing to build the road on the same terms as the Windsor, Amherstburg & Lake Erie Railway, whose by-law was defeated.

The Dominion Wire Company, of Montreal, have elected officers as follows: James Cooper, president; C. W. Vollmann, vice-president; J. C. McCormick, managing director; F. W. Fairman, assistant managing director; H. Horsfall, works superintendent; Albert Hannah, secretary-treasurer.

Mr. Frank Jaynes, general superintendent of the Western Union Telegraph Company, states that his company are preparing to extend their line to Victoria and Vancouver, B.C. The route likely to be adopted is the one followed by the C. P. R. cable, a land line being built from Anacortes to the Terminal City.

The electric lighting system was recently inaugurated at Magog, Que., and is said to be very satisfactory. For private lighting the following rates are charged for 16 c.p. lights: Private dwellings—3 lights, \$3.25 per annum each; 4 to 5, \$3 each; 6 to 9, \$2.50 each; 10 to 19, \$2.25 each; 20 and over, \$2 each. Stores—3 lights, \$4 per annum each; 4 to 5, \$3.25 each; 6 to 9, \$3 each; 10 to 19, \$2.50 each; 20 and over, \$2.20 each.

David Russell, of Montreal, John Joyce, of Boston, William Straham, and others, will apply to the Quebec Legislature for incorporation as the Shawenegan Water & Power Company, with power to acquire and develop water powers on the Saint Maurice and Shawenegan rivers; for general powers for the development of power, generation of electricity, the sale and leasing of the same, and the manufacture of calcium carbide, acetylene gas, electric light and other products.

At the Toronto Technical School 171 pupils have succeeded in taking certificates during the past year, and four have been awarded diplomas. Those winning diplomas are as follows: J. Chalkley, trigonometry, applied mechanics, perspective, graphic statics, descriptive geometry, and building construction; Walter Inglehart, applied mechanics, steam engine, electricity, machine drawing, and machine construction; E. W. Adams, trigonometry, applied mechanics, steam engine, sound, light, graphic statics, and euclid; R. H. Chalkley, trigonometry, applied mechanics, algebra, euclid, perspective, graphic statics, descriptive geometry, and building construction.

The Standard Light and Power Co. has absorbed the Temple Electric Co., situated on Chenneville street, Montreal, which supplies electricity to a large number of business firms. The deal was practically arranged a month ago, but the directors of the Temple Company only recently met and gave a formal consent to the sale, which makes the Standard Company one of the most important electrical concerns in Canada. The Lachine Rapids Hydraulic & Land Company will in future furnish the power to the Standard Company under a contract just made, and which means the turning over of many thousands of dollars. The Lachine Company has also brought to a successful consummation its efforts to supply power to the Imperial Electric Co. for five years.

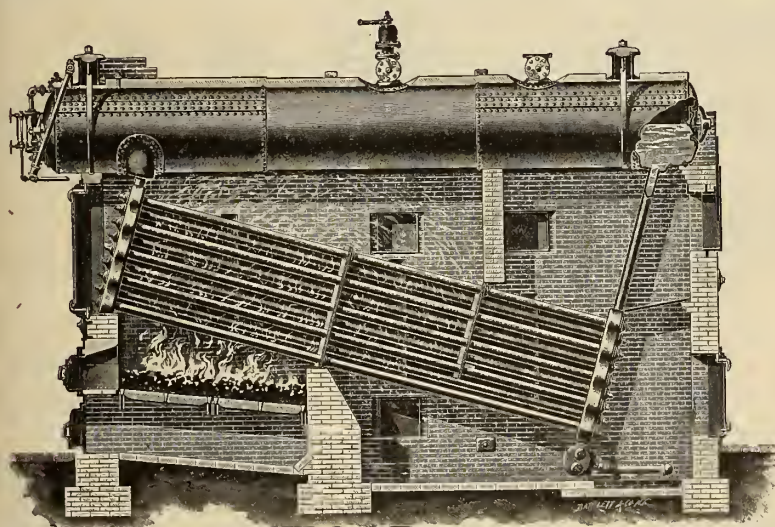
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SPARKS.

Taylor, Telfer & Co. are successors to the electrical supply business of C. W. Henderson, Bleury street, Montreal.

The Royal Electric Company have taken over the electric light plant at Aurora, Ont., from the Metropolitan Lighting Company.

The Canadian General Electric Company are installing a 100-light incandescent plant for the Tillson Company, Limited, of Tillsonburg, Ont.

The St. Lawrence Sugar Refinery Company, of Montreal, have placed an order for two 45-kilowatt incandescent lighting dynamos with the Canadian General Electric Company.

The car barn of the Port Arthur Electric Street Railway, including rolling stock, was burned to the ground on December 15th. The railway and plant is owned by the town.

The street car system at Moncton, N.B., has not been a financial success, and the directors of the company have decided to discontinue the service during the winter months.

The Edwardsburg Starch Co., of Cardinal, Ont., are installing a 1,000-light incandescent plant. The Canadian General Electric Company have the contract for the complete installation.

Mr. J. B. McWilliams, of Peterboro', Ont., is said to have interested English capitalists in the water power of the Otonabee river, and as a result a company may be formed to develop the power.

The British Columbia Electric Railway Company is now experimenting with two kinds of fenders on their cars in Victoria, and the one found most satisfactory will be adopted for the cars of the entire system.

The Auburn Power Company, of Peterboro', Ont., have placed an order with the Wm. Hamilton Mfg. Co., of that town, for two new water wheels. These wheels will enable the company to double their electrical output.

It is proposed to hold a "Pan-American" exhibition in 1899. The site proposed is Cayuga Island, containing about 175 acres on the Niagara river, a few miles above the Falls. In view of the vast amount of power in the vicinity, it has been suggested to the promoters that electricity should predominate in the exhibition, including the restaurants, where the products of electrical cooking will be obtainable in a variety of forms.



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TRADE NOTES.

The Canadian General Electric Company are supplying a 350-light incandescent plant for the new Booth elevator at Parry Sound.

The Windsor Plaster Co., Windsor, N. S., are lighting their works by electricity, and have given the order for the electrical equipment to the Royal Electric Co.

The Kent Mills Company, of Chatham, Ont., have purchased an incandescent lighting generator from the Canadian General Electric Company.

The Dominion Paper Mills, of Kingsey Falls, Que., are installing an electric lighting plant in their new mills, and have placed the contract with the Royal Electric Co.

The Thompson Electric Co., of Hamilton, have recently sold a 35-light arc plant, complete, to the corporation of Parrsboro, Nova Scotia, and a plant of same capacity to the Port Dover Electric Light Co.

The Virginia Mines at Rossland have passed the preliminary stage, and will now enter the list of shippers. An order for a large hoisting plant, with boilers, has been placed with the Rossland branch of the Jenckes Machine Co., of Sherbrooke, and is now on the way from the east.

Attention is called to the announcement in the advertisement pages of this number that the name of the Kay Electric Manufacturing Co., of Hamilton, has been changed to the Hamilton Electric Manufacturing Co. The business of the company will be continued under the new name at the same address as before.

The Weeks-Eldred Co., of Toronto, have removed from the Board of Trade to No. 80 Canada Life Building, where they have very convenient offices. This company recently placed one of their Jones underfeed mechanical stokers in the Windsor Hotel, Montreal, and the value thereof may be estimated from the fact that it is said to have effected a saving of \$150 per week.

The W. A. Johnson Electric Company recently sold a 100-light arc dynamo to the Citizens Telephone and Electric Company, of Rat Portage, Ont. This is claimed to be the largest arc machine yet manufactured for sale in Canada. A letter from the company states that the dynamo is very satisfactory, a noticeable feature being the absence of undue sparking at the brushes.

The Canadian General Electric Company have recently closed a contract with the Bushnell Oil Company, of Sarnia, for a 25-kilowatt, direct connected, steel frame, incandescent lighting generator, coupled to an Ideal engine. This installation will embody all the latest improvements in direct connected practice, which the Bushnell Company, from their connection with the Standard Oil Company of the United States, have learned to value through their experience there.

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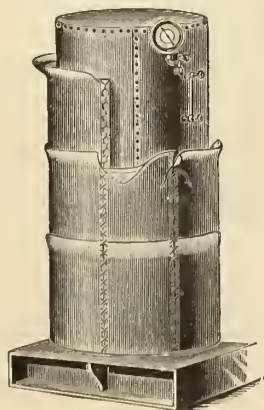
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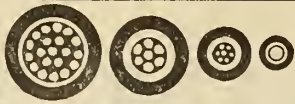
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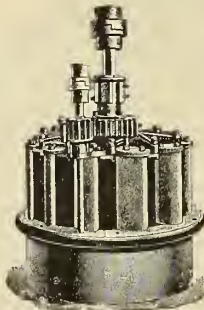
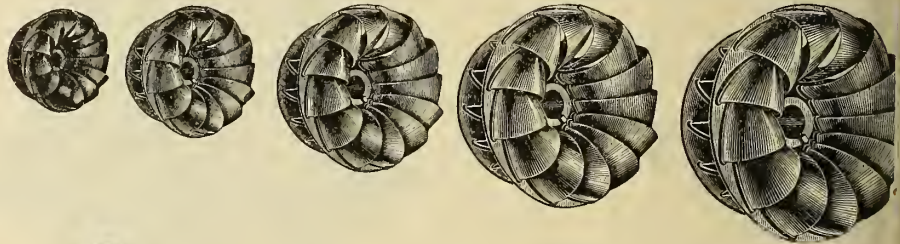
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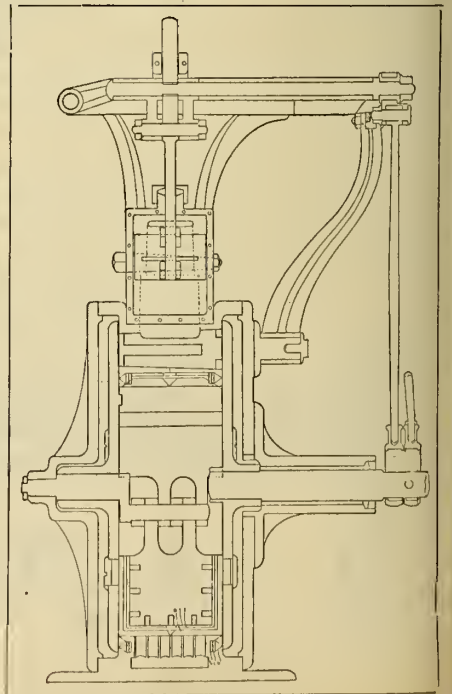
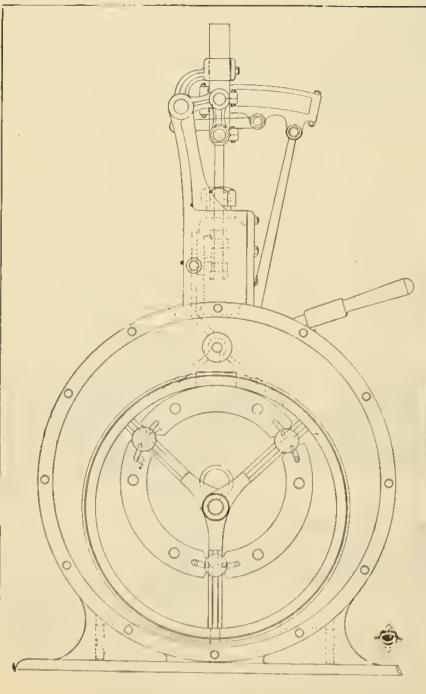
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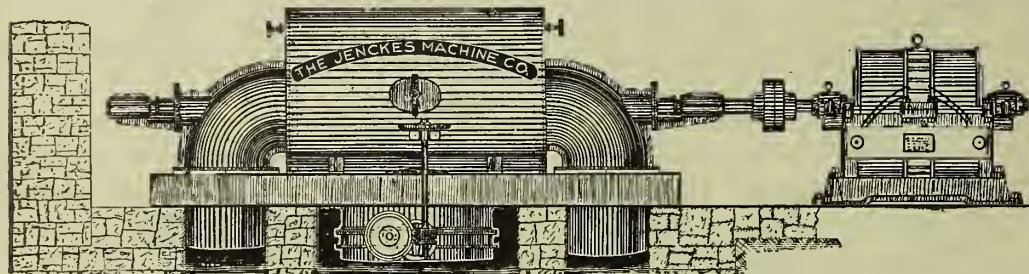
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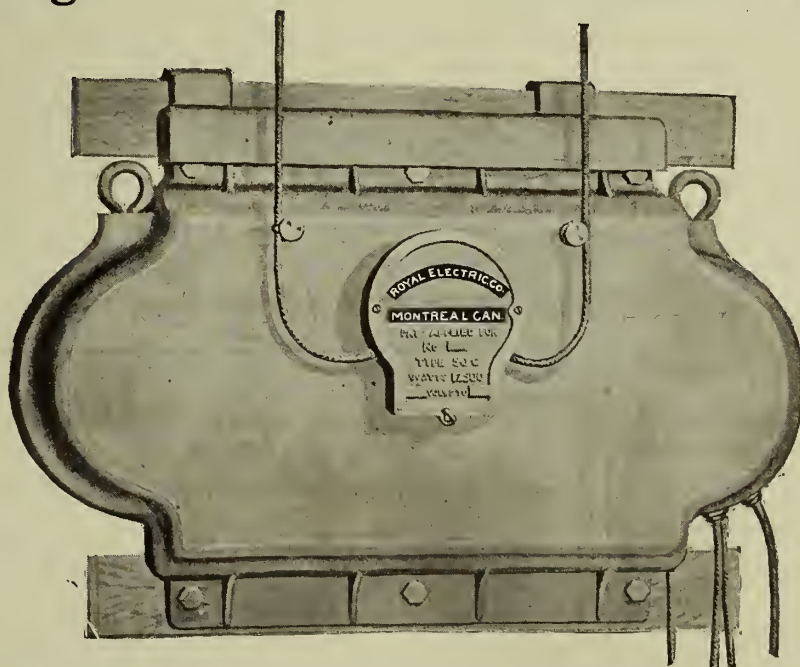
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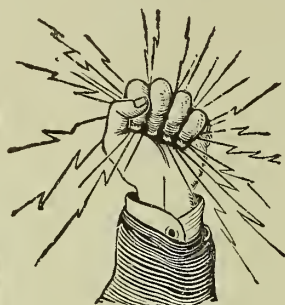
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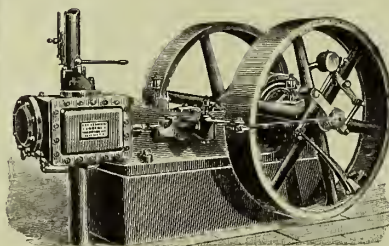
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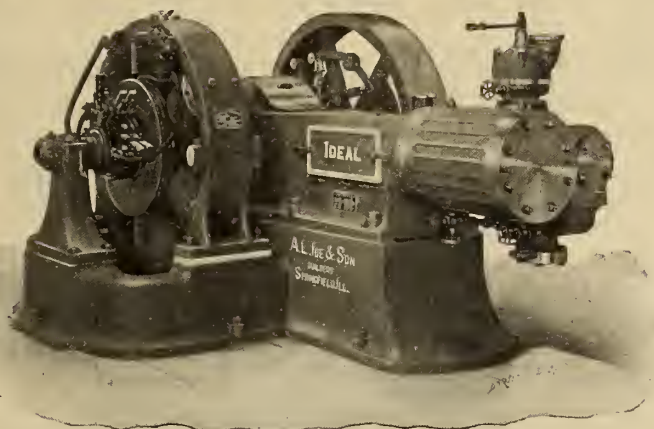
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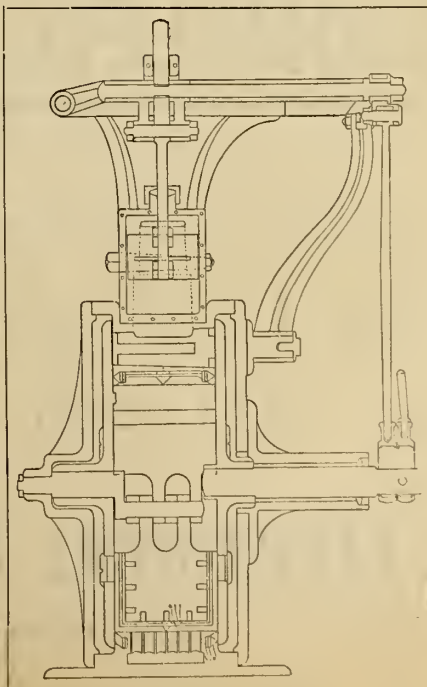
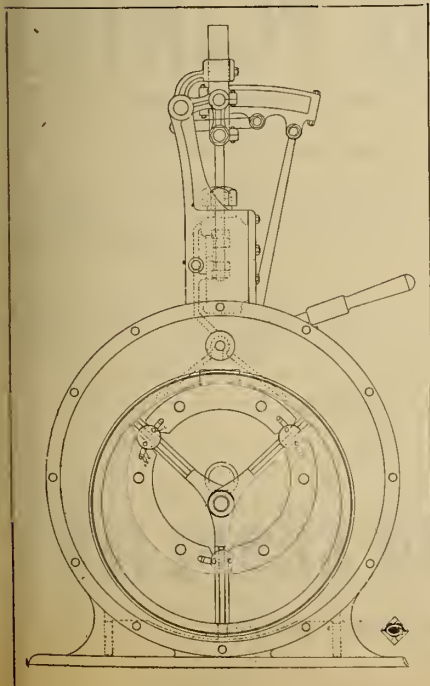
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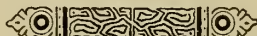
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CANADIAN
ELECTRICAL NEWS
AND
STEAM ENGINEERING JOURNAL.

VOL. VIII.

FEBRUARY, 1898

No. 2.

MR. E. H. KEATING.

MR. E. H. Keating, who for the past six years has been city engineer of Toronto, resigned that position on January 31st last to assume the management of the Toronto street railway. Mr. F. L. Wanklyn, who had been acting as manager of both the Toronto and Montreal railways, found that his duties in Montreal would require his undivided attention, and hence the need of a resident manager in Toronto.

While Mr. Keating's resignation as city engineer was the subject of general regret by Toronto citizens, there were also heard many expressions of pleasure that his connection with the city was not to be entirely severed; on the contrary, in his new field the citizens may rely upon every consistent effort being put forth to afford both quick and comfortable transportation. The company alike must certainly feel that in Mr. Keating they have an officer possessed of executive ability of the highest order.

The subject of this sketch has had a varied civil engineering experience. He was born in Halifax, N. S., in the year 1844, and completed his education at Dalhousie College. After graduating, he served for some time under George Wyhtman, the Government engineer. He took part in the survey of the Pictou Railway in 1867, under that famous engineer, Mr. Sandford Fleming. A little later he was appointed assistant engineer of the Intercolonial, and for a short time was draughtsman on the Windsor and Annapolis railway, returning to the Intercolonial during the construction period.

In 1870, when the work of surveying was entered into on the highlands between Hudson Bay and Lake Superior, for the Canadian Pacific Railway, Mr. Keating again engaged under Mr. Sandford Fleming, and did good service in this particular work. In the same year he accepted the position of City Engineer of Halifax. This position he held from 1871 to 1890, having charge of the construction of many important civic works, particularly the waterworks and the Halifax graving dock. During this time he also practised as consulting engineer, and evidence of his skill and ability in engineering directions is scattered throughout the province of Nova Scotia. In 1890 he was offered and accepted the position of City Engineer of Duluth, remaining there until July, 1892, when he became City Engineer of Toronto. In this capacity he carried out some of the most important contracts ever undertaken by the city,

and acquitted himself in such a manner as to prove beyond a doubt his exceptional ability. While the street railway system was being changed to electric traction, his services were frequently called into requisition in the interest of the city. In this way he became quite familiar with the working of the system, and obtained an experience which should serve him to advantage in his present position.

PROGRESS OF THE KOOTENAY POWER PLANT.

THE work of developing the water power available at the Falls of the Kootenay river, in British Columbia, which has been undertaken by the West Kootenay

Power and Light Company, is nearing completion. The machinery is now being installed, and early in March the company hope to be supplying electric power for the various mining operations within a radius of fifty miles of Rossland.

As already stated in this journal, the promoters of the enterprise are Sir Charles Ross, the Scotch baronet, Messrs. C. R. Hosmer, Frank Paul, Wm. Doull, and other well-known capitalists. In a recent interview Sir Charles Ross gave some interesting particulars of the undertaking and proposed operations of the company.

The power house of the company is situated at Bennington Falls, about 10 miles below Nelson, on

the Kootenay river. Water is conducted to the reservoir from the Kootenay river by a canal-way 30 feet deep and 27 feet wide, cut out of the solid rock for a distance of 640 feet. The dam, which is of concrete, is 32 feet high and 18 feet thick at the base. It extends for the full distance across the fore-bay, some 54 feet, and is reinforced on the sides by huge abutments of concrete. The average rise of the Kootenay river is 22 feet, and the highest flood on record was 32 feet above the minimum height of the stream. The dam, therefore, is calculated to withstand the severest floods which it is likely to encounter. From the fore-bay the water is carried to the turbine wheels by three steel pipes, two of which are nine feet in diameter, while the third is a foot larger. At present only the two former tubes will be used. The wheels will develop 1,450 horse power each, so that their united force is 2,900 horse power. Each wheel weighs 40,000 pounds.

The turbine wheels are attached direct to the gen-



MR. E. H. KEATING,
Manager Toronto Street Railway Company.

erators, without the use of gearing. The gates for regulating the supply of water are electrically governed. The electrical apparatus, which was furnished by the Canadian General Electric Company, is of the three-phase alternating type, similar to that installed at Montreal for the Lachine Rapids Hydraulic & Land Company. There are two generators, having together a capacity of 2,500 h.p., giving a voltage of 1,040 when revolving at 180 rev. per minute. The exciters used in connection with the generators are operated by two special turbine wheels of their own. The generators are connected by heavy cables to a marble switchboard, from which the current is connected to the step-up transformers, which increase the pressure from 1,040 to 20,000 volts. The electrical current is conducted to the sub-station at Rossland over a three-wire line 30½ miles long. The local sub-section, which is situated on the Monte Cristo ground, is equipped with a high potential switchboard, a distributing switchboard and a series of transformers, which reduce the pressure from 20,000 to 2,080 volts. From the sub-station power will be conducted to the various mines, and where necessary, still further reduced for transmission to the motors.

The president of the company is Mr. Oliver Durant. Mr. Robert Jamieson, formerly engineer for the Lilloet, Fraser River & Caribou Gold Fields Co., is general manager and chief engineer, and Mr. L. A. Campbell installing expert for the Canadian General Electric Company.

MICA PRODUCTION IN CANADA.

THE immense quantities of mica found in Canada, and its increasing use for electrical and other purposes, is attracting capitalists to the mica properties of this country. The United States and Great Britain use our mica quite extensively, and with the growth of the electrical business the demand promises to become much greater. As early as 1863 Sir William Logan referred to the deposits of "muscovite," or "white mica," then known to exist on Yeo's Island, Cape Tourmente, and other sections of the province of Quebec. Mention is made in his *Geology of Canada* of the phlogophites or "amber" mica at Grenville, Quebec, and in North and South Burgess, Ontario, in all of which the mica is obtained in large sheets, which, being transparent and free from flaws, are wrought and employed for the same purpose as the "muscovite" or potash varieties. An early producer was the Sydenham property, in the Kingston district, and the important deposit of "muscovite," particularly referred to by Dr. A. R. C. Selwyn, C.M.G., F.R.S., director of the Geological Survey of Canada, in the report of the Royal Commission on the Mineral Resources of Ontario, has been opened up at Villeneuve, in Ottawa County, while at Templeton, about 16 miles from the city of Ottawa, several extensive deposits of first-class amber mica, notably on the Wallingford property, have been worked. Dr. Selwyn's opinion of the Villeneuve "muscovite" mica is fully confirmed by another well-known Canadian expert, Prof. F. Cirkel, who has also reported in high terms on the Wallingford and Lake Girard properties.

Mica is a crystalline mineral, which, in association with several other minerals—as pyroxene and felspar—forms the rocks we know as gneiss and granite, and is capable of being cleaved into elastic plates of extreme thinness. Both its color and commercial value are

greatly influenced by the mineralogical peculiarities of the rock in which it occurs or has been associated, and also by the manner in which it has been deposited after the decomposition of the rock in which it originally occurred.

In Great Britain the incandescent gaslight companies are largely using it for chimneys, instead of glass. The insulating power of mica is superior to that of any other substances applicable to armatures and commutators. An advantage peculiar to itself is its even laminated structure. The builders of armatures can split sheets into any desired and uniform thickness with great ease and accuracy. A valuable property of mica in connection with commutator insulation is its degree of hardness; it does not wear away too rapidly under the action of the brushes. Of all substances, mica is probably the best material for insulation in certain parts of armatures if it is desired to obtain not only efficient electric insulation but also durability under the influence of heat. The highest temperature to which an armature is subjected, even by short circuits or bad constructions, will have no injurious effect on mica, thick or thin. It may be held in a gas flame without burning or melting. It has been proved that a sheet of 4 in. in thickness will stand the strain of a voltage of close upon 5,000 volts. Mica being infusible, tough, non-combustible, and, when split in sheets, transparent, has a multiplicity of industrial uses.

The mineral is somewhat extensively used in the manufacture of mica grease. As a lubricant for railroad purposes, bicycles, etc., its value lies in its absolute anti-friction, and it is claimed that with its use hot boxes or journals are impossible. A profitable employment of the immense quantities of scraps and fragments of waste mica is the substitution of mica for glass in spectacles worn by workmen (such as electric welders and stone and metal workers) to protect their eyes from sparks, chips or splinters. These mica glasses are concave, in the shape of watch glasses, and are about 1-25th of an inch in thickness. The advantages gained by this utilization are greater than would at first be imagined. Mica spectacles have the advantage over glass that they cannot be broken. Pounding with a sledge hammer merely flattens them, nor does a splash of molten metal coming in contact affect the mica eye-shade.

One of the most recent uses to which mica is commercially applied is in the manufacture of "micanite," by which large quantities of scrap or inferior qualities are utilized, and, by means of a patented process, small pieces of waste mica are built up into sheets 40 in. square, and larger if necessary. This product can be made in any desired form, and is also largely supplied to the electrical trade for insulating purposes. As a covering for boilers mica possesses various advantages over any other material. Many other ways of utilizing mica might be given, but enough has been said to show that there is an ample market for a material with which the electrical industry is already very familiar.

WELL PLEASED.

MR. William T. Frizzell, Chief Engineer Consumers Cordage Co., Dartmouth, Nova Scotia, in renewing his subscription to the *ELECTRICAL NEWS*, writes: "Please send me January's copy, as I do not wish to miss a number. I am well pleased with the paper, I think it is growing more interesting."

BY THE WAY.

THE woman has now invaded the electrical field. Word comes from Syracuse, N. Y., that a new opera house there has just been wired by Mrs. W. J. Blackburn, wife of a theatrical electrician. She had full charge of the work, which was quite complicated, and included 1,250 incandescent lights for the auditorium, stage and lobby. Mrs. Blackburn is said to make a specialty of designing switchboards, and has assisted her husband in many important contracts. She is believed to be the only woman in America engaged in this class of work.

x x x

IN a certain Canadian city a widow and her two sons kept store on a leading thoroughfare. We will call their name Jones. The sons' initials are respectively R. J. and J. W. The former after a time decided to leave the paternal roof, and commenced business on his own account on the same street. This was the starting point of keen business rivalry. R. J. Jones transposed his initials in order to have his name appear first on the Telephone Company's list of subscribers. Before the next issue of the book, his brother had caught on to the scheme, and notified the manager of the Telephone Exchange that the name was not correctly printed, and that it should appear in its proper alphabetical order further down the list. Soon after the new directory list containing this correction was published, R. J. called the telephone manager's attention to the fact that the business with which his brother was connected belonged to his mother, and that consequently the name in the directory should be "Mrs. J. W. Jones." R. J.'s star is thus once more in the ascendant, and the telephone manager is quietly waiting to see what is to be the next move on the board.

THE KINGSLEY WATER TUBE STEAM BOILER.

THIS boiler, which has been installed in a large number of steam plants in Canada during the last year, stands with the highest records and recommendations from its users.

Perhaps its merits cannot be better summarized than by quoting from the report of this boiler made by the American Institute of New York: "We submit herewith a report of test made by us, assisted by Messrs. Jacobus and Treber, of Stevens Institute of Technology, and while making the same, discovered the following points, which are worthy of special commendation, viz.: The large amount of power developed in the small space occupied; rapid steam formation in the small space occupied; rapid steam formation without any foaming; very dry steam from water of evaporation. The construction of the boiler is such that it can be built to withstand any pressure desirable, and all parts are readily accessible for cleaning and repairs when necessary. The tubes are very readily removed and new ones replaced."

The Franklin Institute of Philadelphia reported after their tests that the Kingsley boiler does one-third more work per pound of coal than does the return tubular boiler.

The tubes are perfectly free from sediment at all times, as can be verified by all boilers now in use, and they have withstood the hardest service for many years.

This water tube boiler can be sold at a moderate price, and is now manufactured by several of the foremost shops in Canada. The advertisement appears in this issue, and next month we will fully describe and illustrate the boiler.

MACHINES.*

A MACHINE is an instrument by means of which a force applied at one point is able to exert at some other point a force differing in direction and intensity. It has been usual in treating of simple machines to call the applied force the power, but the word power is now in use with an entirely different meaning, and so we shall accordingly speak of this applied force as the effort. The force exerted or effective resistance overcome is usually called the weight. This resistance may be the earth's attraction, as in raising a heavy body, or it may be the molecular attractions between the particles of a body as in stamping metal or dividing wood, or it may be friction as in drawing a heavy body along a rough road.

Besides the effective resistance, the effort is employed in overcoming the internal resistances chiefly due to friction which always exists between the different parts of a machine. The effort may be just sufficient to overcome these two kinds of resistance, or it may be in excess of what is necessary or it may be too small. If just sufficient, the machine once in motion will remain uniformly so, or if it be at rest it will be on the point of moving, and the force applied or effort will be in equilibrium with the effective and internal resistances. If the effort be in excess the machine will be set in motion, and will continue to move with an accelerated motion. If the effort be too small it will not be able to move the machine, and if the machine be already in motion it will gradually come to rest. When the effort is just sufficient to overcome the resistance, the ratio of the resistance to the effort is called the modulus of the machine. In this case it is evident from the law of Conservation of Energy, that the work done by the effort has its equivalent in the work done against the effective resistance to be overcome, and against the resistance due to the friction between the parts. This is the general law of machines in motion or in equilibrium.

The ratio of the effective resistance which we call simply the resistance to the effort is equal to the ratio between the distance through which the effort acts, and the distance through which the resistance is overcome at the same time; or in other words, is equal to the ratio of the velocities of the points of application of the effort and resistance, or if we take equal distance and uniform motion, we see that what is gained in force is lost in time.

Simple machines, sometimes called the mechanical powers, may be considered under three heads: 1, a solid body movable around a fixed point; 2, a flexible string; 3, a hard inclined surface.

Under No. 1 come machines acting on a lever and wheel and axle, such as the crowbar, etc. In this case the difference between the power and fulcrum is greater than the difference between the fulcrum and weight. In the case of the wheelbarrow, row-boat, etc., the power is at one end, the fulcrum at the other and the weight between the two. In the human arm the weight is at one end, the fulcrum at the other, and the power between.

Under No. 2 come pulleys. In the case of the single pulley the power exerted must be equal to the weight; it simply changes the direction of the force. Where more than one pulley is used as in one block, the first one would support the whole weight, which we will say is 100 lbs., the 2nd pulley would support one-half of what is supported by the first, or 50 lbs., the third would hold or support one-half of what is supported by the second, or 25 lbs.; the force therefore required to lift the 100 lbs. would only be equal to 25 lbs., but as it has already been said, what is gained in force is lost in time.

No. 3, inclined surfaces, includes the wedge and screw. To take a weight up an inclined plane, the weight and height must be equal to the power and length. In the screw, the power and circumference, equals the weight, and distance between threads.

* Paper by Jas. Gill, Teacher in Physics at Normal School, read before Hamilton No. 2, C.A.S.E., January 11th, 1898.

ELECTRICITY IN MODERN BUILDINGS.

By "ELECTRICIAN."

IN the construction of a certain class of building a steel framework, filled in with stone or other material, is being very largely used, and as electricity is rapidly becoming the means of distributing light and power, and to some extent, even heat, throughout the halls, corridors, offices, etc., of any building which proposes to offer all the best modern conveniences, it may be worth while to consider whether there will take place any interaction between the steel framework, considered as a conducting network of comparatively low resistance, and the electrical circuits which distribute the lighting and power currents. It is, of course, evident that such a steel framework will offer a path of comparatively low resistance to any current that may be set up in it, and it is the purpose of this article to formulate those conditions which will tend to the setting up of such currents, and their physical effect on the building materials.

Regarded as a conducting network, currents may be set up in the steel framework by either induction or by direct contact (leakage being included as a contact). The diagram shows in section an electric light wire "a" through which a current is flow-



ing, and a conductor "b" of some kind of conducting material—"a" and "b" being fairly close to each other, and more or less parallel during their length. At the instant of starting a current through "a" the whole space around "a" becomes an inductive field of rapidly increasing intensity, which will include the space surrounding "b," and this is a necessary and sufficient condition for the setting up of a current in "b," so that it will appear that actual contact is not required in order that a current may flow in "b". Similarly at the moment of stopping the current flowing through "a," a current will be induced in "b". If the current in "a" be stopped and started, or reversed in direction rapidly, or even made to wax and wane—that is, to merely fluctuate without actual reversal—currents will under all these conditions be induced in "b," and their strength will be proportional to: The conductivity of "b"; the strength of current in "a"; the rate of variation or fluctuation of the inductive field; the length of the conductor "b" that is in the inductive field—their distance apart. It is therefore conceivable that very considerable currents can be made to flow in "b" without any contact with "a." They will probably be currents of low voltage, but still capable of effecting considerable electrolytic damage. It is sufficiently obvious that contact between a conductor carrying current and a steel beam, whether it be direct mechanical contact or indirectly through a leak caused by damp, etc., will result similarly.

Suppose we have a steel frame building with a complete system of electrical distribution—for lighting, elevators, fans, heaters, etc.—it can easily be imagined that there may be set up inductively a most complicated and interlinked system of active currents in the various uprights and horizontals forming the frame, and that they may be of quite considerable magnitude. This can occur not only in the steel frame itself, but in the piping for the heating or auxiliary gas lighting services. With a direct current distribution for lighting only, these induced currents would probably have a negligible effect, as it is only at the moment of make and break that inductive action would take place, although even in such a case a direct current, though continuous in direction, will have sufficient very small fluctuations in strength (owing to the fact that the number of coils in the armature is not infinity) to keep up a continual alternating current in all the pipes and beams parallel to it and within the sphere of its influence. But in very many cases current is distributed for elevator and motor purposes, and here we find not only the small fluctuations due (as mentioned above) to the armature construction, but also that fluctuation due to the varying demands of the elevator and motor services, which, while not so rapid, will have an enormously greater amplitude, and so a much greater inductive influence. There are very many buildings, moreover, that employ an alternating current for lighting, the influence of which requires no pointing out. So that it

appears that there will always be some circuits induced in such buildings, whether in the frame or the piping.

An electric current flowing in a circuit must produce one effect and may produce more. It must heat the conductor and may decompose it. The heat generated in the conductor depends on the amount of current flowing, and on the resistance offered to it, and in a circuit of varying conductivity the greatest heat will be generated at the point of greatest resistance. In a circuit composed of beams the points of junction will be those of highest resistance, and will therefore be the heating points. Just how far the expansion and contraction due to heating and cooling may be expected to work with the natural vibration to loosen the joints, is a matter that affords a very interesting field for discussion and experiment. But if it be granted that it does have the effect of so loosening them, then such loosening will tend to promote the decomposing action of the current flowing, with the assistance of whatever slight amount of moisture has condensed out of the atmosphere (or elsewhere) on the opposing faces of the loose joint. This latter action of the current is probably of greater importance than the former, as its tendency is to loosen by decomposition, and just where the utmost rigidity and permanence is desired, viz., in the foundations. The electrolytic injury would take place just at the base of a steel pillar, where the current was able to escape to earth, and the effect would be to eat away the metal, as the iron of water pipes is eaten away by the passage of railway currents. The electrolysis of gas and water pipes might be even a serious matter unless precautions be taken to minimize its effect.

While it seems impossible to so arrange as that there shall be no induced currents in framework or piping, still it is possible, and in most cases would be well, to adopt such precautions as will confine them within such small limits that they may become negligible. It would be well to thoroughly ground the entire steel structure by copper wires of large section leading from various points to the earth, and making good contact there with permanently moist soil. It would also be advisable in laying out circuits to so arrange that all those wires carrying the main current shall be as far removed as possible from any of the structure, and as close together as insurance regulations will permit. If it be necessary for the main wires to be close to a pipe or pillar, and to run parallel to it, then they should be placed one on each side of it so as to neutralize each other's effect.

PUBLICATIONS.

The publishers of Power, of New York, have eclipsed all previous efforts by their issue for December. It is replete with interesting articles on engineering subjects, while the advertisements many of them printed in various colors, present an attractiveness not often equalled. The frontispiece is especially worthy of mention.

The Canadian General Electric Company have issued an artistic lithograph calendar, in which blue and gold are the predominating colors. The figures of the calendar are large and clear. Above them is a female figure holding aloft in one hand an incandescent lamp, while with the other she draws aside a curtain, revealing in perspective a view of the company's works at Peterborough, Ont.

A valuable addition to the literature of British Columbia is the year book which has just been published by Mr. R. E. Gosnell, Legislative Librarian, with a copy of which we have been favored. Of the many works which reach our table, most of them of considerable merit, the credit for the most complete work of this character yet received must be given to the author of the British Columbia Year Book. Besides the facts and figures relating to the natural resources of the province, there is sufficient of an historical, political and sociological character to render the book interesting and instructive to all. There are over 500 pages of letterpress and illustrations, so arranged as to present a most pleasing appearance. To even mention the interesting features would involve more space than can here be given, suffice it to say that among them are the following: An historical review, including portraits of early navigators and explorers; a group of pioneers and early legislators; portraits of members of parliament; illustrations of government buildings; a treatise of 100 pages on mines and mining, with illustrations; a description of the fisheries and maps of different districts in British Columbia.

THE ARNPRIOR ELECTRIC LIGHT PLANT.

THE power house of the Arnprior Electric Light plant is a substantial stone building, 70 x 40 feet, two storeys high, and fitted for both water power and steam, which may be used either separately or in conjunction. The water wheel is a 100 horse power turbine, and the engine a 100 h. p. Warwick. The boiler room is separated from the other rooms of the building by solid brick walls, fitted with fire-proof doors.

The generators consist of a Thomson-Houston 1,000 light generator and two Ball arc dynamos, the switch-board being fitted with Thomson-Houston instruments.



MR. S. SHEPPARD.

One of the principal features of this plant is the fitting of the shafting with friction clutch pulleys, thus enabling the instantaneous throwing on or off of any of the machines. Another ingenious arrangement of the electrician in charge of the plant is a mirror suspended on a bracket at the side of the volt and ampere meter, with strong magnifying glasses on a swinging arm, so that the voltage can be read from any part of the room or from the outside of the doorway opening into the operating room.

The company have installed 24 arc street lamps and about 1,000 incandescent lights, and are giving a very satisfactory service.

Mr. S. Sheppard, the electrician, whose portrait we present, is a native Canadian, and was born in Ottawa, May 11th, 1873. He is a thoroughly qualified electrician, and keeps the plant in first class condition. After leaving school Mr. Sheppard entered a machine shop, and after a couple of years entered the employ of the Ottawa Electric Co., with which firm he was engaged for five years, a greater part of the time in their repair and manufacturing department, leaving that company in April, 1896, to accept his present position.

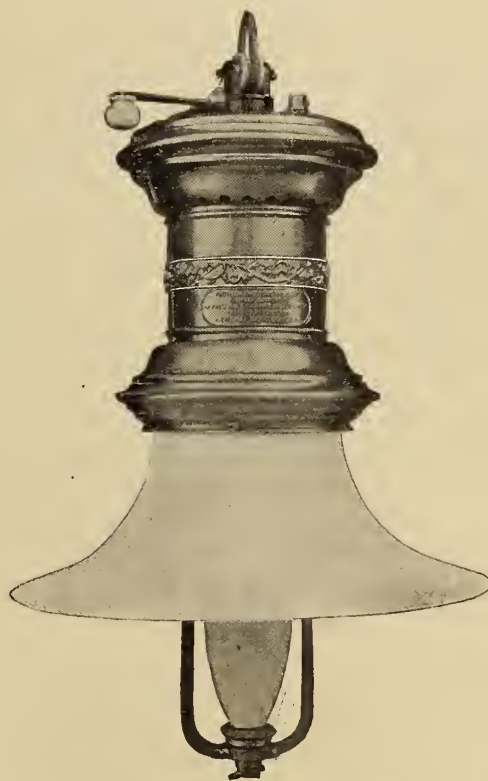
FELT MATS FOR ENGINES.

WOOL fibre seems to be about the only material that can be formed into a substance so firm and solid that it can be given the absurd name of "iron felt." In the manufacture of this material, London Engineering says that the best long wool fibre is first impregnated with petroleum grease, and further to a certain depth with glue, which is rendered insoluble by the addition of bichromate or formaldehyde; in certain cases the surface is prepared with vulcanite rubber and then vulcanized. The stuff is very highly compressed and supplied

in plates up to 2 feet square and more, from 0.4 inch to 2 inches in thickness. The plates are elastic; withstand, according to tests conducted at the Reichsanstalt, a pressure of about 9 tons per square inch; do not rot, and the surface is said to be so hard that the edges of rails and bolts do not cut into it. The mats are placed under the rails of tramways, etc., in order to deaden the noise and clatter. For the same reason, a layer of this felt may be interposed between the foundations and the base plates of engines, and underneath the bearing of shafting in workshops. The mats must not overlap, and may be applied in layers. In the case of workshops it may also prove profitable to provide the respective joists and girders with mats. That the material is electrically an insulator would be an additional advantage. The chief question is, of course, whether the elasticity of the felt will last long enough to justify its practical adoption in engine rooms and workshops, where we do not like to risk experiments.

SINGLE GLOBE ENCLOSED ARC LAMP.

THE Canadian General Electric Company, Limited, Toronto and Peterboro', has recently placed upon the market a new type of enclosed arc lamp, for indoor use, an illustration of which we give herewith. This lamp is made for both direct and alternating (60 or 125 cycles) circuits, and for three and five amp. currents. In many cases the three amp. lamp can be used with advantage, on account of the greater volume of light produced as compared with the double globe lamp. These lamps are handsome in appearance, and can be



SINGLE GLOBE ENCLOSED ARC LAMP.

furnished in either black or bronze ornamentation. They are very desirable for all kinds of inside lighting, and their combined qualities of simplicity and economy should commend these new improved lamps to all central station men and owners of isolated plants. Further particulars can be obtained from the above company.

The Robb Engineering Company, Ltd., of Amherst, N. S., recently suffered slight damage by fire. The loss is covered by insurance.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

NOTE.—Secretaries of Associations are requested to forward matter for publication in this Department not later than the 28th of each month.

TORONTO NO. 1.

MR. J. W. Marr, the popular secretary of Toronto No. 1, who had been in the employ of the T. Eaton Company for some time, has accepted a position in the power house of the Metropolitan Street Railway Company. His address is Box 155, Davisville.

The regular meeting of Toronto No. 1 was held on January 19th, when there was a good attendance and one initiation. The committee reported regarding the annual At-Home. It had been found necessary to draw on the Association funds for furnishing and decorating the hall, the insurance not being sufficient to cover the cost of the necessary repairs. On February 8th Mr. A. M. Wickens continued his lecture on "The Indicator."

On Thursday evening, Feb. 3rd, the Engineers' Hall, 61 Victoria street, was the scene of gay festivities, the event being the third annual At Home of Toronto No. 1. The engineers and their friends to the number of 150 had assembled there to participate in the evening's entertainment, which included a first-class musical programme, dancing, etc. The following contributed: Piano, Master Huggett; songs, Mr. Dimmock, Miss Lewis, Mr. T. Vice, Mr. G. T. Pendrith, Mr. Newton; reading, Mr. C. H. Fielding. The accompanist was Mr. A. E. Harding. Refreshments and an impromptu dance followed the above programme. The affair was quite a success.

TORONTO NO. 2.

A new branch of the Canadian Association of Stationary Engineers has been formed in Toronto, to be known as Toronto No. 2. On Saturday evening, January 15th, the following officers were installed by the Executive President, Mr. E. J. Phillip, assisted by the officers of Toronto No. 1: Past President, P. Trowern; President, John Dixon; Vice-President, John H. Venables; Recording Secretary, Thos. Graham, 570 King street west; Financial Secretary, J. Richardson; Treasurer, Joseph Hughes; Finance Committee, F. Tushingham, E. Thomas, T. L. Holmes; Trustees, John Dixon, J. McMulken, P. Trowern; Conductor, M. Connoley; Doorkeeper, H. Brown.

Immediately after the installation ceremonies, President Dixon delivered his maiden speech, and in conclusion invited the visiting brethren from Toronto No. 1 to partake of refreshments, when ample justice was done to the elaborate supper which had been prepared by the wives and daughters of No. 2.

BRANTFORD NO. 4.

At the last meeting of the Telephone City association, all the former officers excepting the treasurer were re-elected. General business comprised the chief work of the evening.

KINGSTON NO. 10.

At a recent meeting of Kingston No. 10, a committee was appointed to wait upon the members of the Dominion government to solicit their support in behalf of the Steam Boilers' Act, which provides for the proper examination of engineers and the inspection of boilers. The government will also be asked to appoint a resident examiner in the Kingston district. Since the meeting, the Association have received the promise of the local members to support the bill, which will shortly come before the House.

TORQUE AND SPEED OF MOTORS.*

BEFORE we go into the matter of torque, it may be beneficial to go over, briefly, some of the units of electrical measurement:

FORCE is that which produces motion or change of motion in a body. The unit of force is that force which, when acting for one second on a mass of one gramme, gives it a velocity of 1 centimeter per second. It is called the DYNE. The force with which the earth attracts any mass is usually called the weight of that mass, and the force with which a body gravitates, i.e., its weight (in dynes) is found by multiplying its mass (in grammes) by the value of g.

WORK is the product of a force and the distance through which it acts. The unit of work is the work done in overcoming unit force through unit distance, i.e., in pushing a body through a distance of one centimeter against a force of one dyne. It is called the ERG. The force with which gravity pulls a mass of one gramme is 981 dynes (981 centimeters = 32.2 feet). Therefore, to lift a mass of one gramme through a distance of 1 centimeter is = 981 ergs of work or g ergs.

POWER is the rate of working. The unit of power is the WATT, and is = 10^7 ergs. per second.

$$1 \text{ foot} = 30.479 \text{ centimeters.}$$

$$1 \text{ lb.} = 7000 \text{ grains.}$$

$$15.432 \text{ grains} = 1 \text{ gram.}$$

$$\therefore \frac{7000}{15.432} = 453.59 \text{ grams, or } 1 \text{ lb.} = 453.59 \text{ grams.}$$

$$1 \text{ foot pound} = g(30.479 \times 453.59) = 13825 \text{ g ergs,}$$

$$= 1357235 \text{ ergs.,}$$

$$\text{generally written } 1.356 \times 10^7 \text{ ergs.}$$

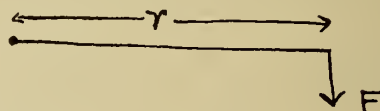
From which is readily deduced:

$$1 \text{ h.p.} = 550 \text{ ft. pds. per second,}$$

$$\therefore 550 \times 1.356 \times 10^7 = \text{ergs in } 1 \text{ h.p.,}$$

$$\text{but } 10^7 \text{ ergs.} = 1 \text{ watt,}$$

$$\therefore \frac{550 \times 1.356 \times 10^7}{10^7} = 746 \text{ watts.}$$



$$Fr = \text{Torque} = T.$$

$$V = \text{Velocity in centimeters per second.}$$

$$F = \text{Force in dynes.}$$

$$W = \text{Work in ergs.}$$

$$N = \text{No. of revs. per second.}$$

$$W = Vf, \text{ but } V = 2\pi r n.$$

$$\therefore W = 2\pi r n f, \text{ but } fr = \text{Torque, } \therefore W = 2\pi n T.$$

As already stated, 1 pd. foot = 1.356×10^7 ergs, or 1.356 watts.

Since electric power is CE , and mechanical power is the speed multiplied by torque, we will now consider if there is any relation between the two.

$$\text{Watts} = EC = 2\pi NT \times 1.356$$

$$\text{where } E = \text{EMF in armature}$$

$$C = \text{total current.}$$

The E.M.F is proportional to the speed if the magnet flux N is constant.

$$\text{i.e., } E = \frac{\text{Rev. per second} \times Nc \times N}{10^8}$$

$$\text{Where } Nc = \text{No. of conductors in armature}$$

$$N = \text{Total flux}$$

$$E = 10^8 \text{ lines cut per second.}$$

If we substitute the value of E in EC we get

$$\frac{R.p.s \times Nc \times N \times C}{10^8} = 2\pi NT \times 1.356$$

$$\text{but } R.p.s = N = \text{Rev. per second}$$

$$\text{by cancellation we get } \frac{Nc.N.c}{10^8} = 2\pi T \times 1.356$$

$$\text{and by transposition } T = \frac{Nc.N.c}{2\pi \times 1.356 \times 10^8}$$

By this we readily see that the torque T does not in any manner depend on the speed, but that it depends on the flux N and on the current, which shows very clearly that if we wish to make a motor have a large torque the flux must be large, and as this formula is applicable to generators, it shows that to make a slow speed dynamo generate the requisite E.M.F, N must also be large.

From the torque can easily be determined the total peripheral

* Paper by Mr. James Milne, read before Toronto No. 1, C.A.S.E.

force, and from the peripheral force the pull on each conductor can be calculated, as follows:

$$\begin{aligned}\text{Total peripheral force} &= \frac{\text{Torque}}{\text{Radius in feet}} \\ \text{Average pull per conductor} &= \frac{\text{Total peripheral force}}{\text{No. of conductors}}\end{aligned}$$

As a rule the number of active conductors is $\frac{2}{3}$ of the total conductors; those conductors in the gap of course are not cutting the lines and must be deducted.

$$\begin{aligned}\therefore \frac{2}{3} \text{ of total conductors} &= \text{No. of active conductors} \\ \therefore \frac{\text{No. of active conductors}}{\text{Total peripheral force}} &= \text{Pull in pounds on each}\end{aligned}$$

The torque of a motor is a maximum when motor is standing still and gradually decreases, and is zero when the counter E.M.F. is the E.M.F. of supply, which can be proved as follows:

$$\begin{aligned}T \text{ (in dyne centimeters)} &= \frac{N_c \cdot N \cdot c}{2\pi} \\ \text{but } C \text{ in a motor is} &= \frac{\text{E.M.F. of Supply} - \text{Counter E.M.F.}}{R \text{ (Resistance of Armature)}}\end{aligned}$$

Substitute this value for C in the equation, and we get:

$$T = \frac{N_c \cdot N \cdot c}{2\pi} \times \frac{E^1 - E}{R}$$

but the counter E.M.F. or E is precisely the same as in a generator = $N_c \cdot \text{Rps. } N$. We are dealing in absolute units at present, and to bring this to volts or practical units would have to be divided by 10^8 .

By substituting $N_c \cdot \text{Rps. } N$ for E, we get:

$$T = \frac{N_c \cdot N}{2\pi} \cdot \left(\frac{E^1 - N_c \cdot \text{Rps. } N}{R} \right)$$

When $\frac{E^1 - N_c \cdot \text{Rps. } N}{R} = E$, or when the C. E.M.F. = E, there is no torque, or $T = 0$.

T is a maximum when $\frac{N_c \cdot N}{2\pi} \left(\frac{E^1 - 0}{R} \right) = \frac{N_c \cdot N \cdot E^1}{2\pi R}$, i.e., when

there is no counter E.M.F., or in other words, when the motor is standing still and current on.

From the above we get:

$$\begin{aligned}T 2\pi R &= N_c \cdot N (E - N_c \cdot \text{Rps. } N) = N_c \cdot N E - N^2 c \cdot N^2 \text{ r.p.s.} \\ \text{r.p.s.} &= \frac{N_c \cdot N E - T 2\pi R}{N_c^2 N^2} = \frac{E}{N_c \cdot N} - \frac{T 2\pi R}{N_c^2 N^2}\end{aligned}$$

and to reduce same to practical units, we have:

$$\text{r.p.s.} = \frac{E \times 10}{N_c \cdot N} - \frac{T 2\pi R \times 10^9}{N_c^2 N^2}$$

The following example taken from actual practice may be found interesting: In a Fensom elevator the speed where $E^1 = 230$ volts, $N = 1,400,000$, current 60 amperes, 1000 conductors, find the torque.

$$T \text{ in pound feet} = \frac{60 \text{ amp.} \times N_c \times N}{108 \times 1.356 \times 2\pi} = \frac{840}{8.52} = 100 \text{ pd. ft., nearly.}$$

The resistance of the armature of this motor was .435 ohms, from which we could easily determine the revs. per second as follows:

$$\text{R.p.s.} = \frac{\text{E.M.F.}}{N_c \cdot N} - \frac{2\pi T R}{N_c^2 N^2}$$

The torque being given in pound feet, it must be reduced to dyne centimeters by multiplying by 1.356×10^7 ,

$$\therefore \text{ revs. per second} = \frac{230 \times 10^8}{1000 \times 1,400,000} - \frac{2\pi \times 1.356 \times 10^7 \times T \cdot R \times 10^9}{1000^2 \times 1,400,000}$$

which when worked out give 14.5 revs. per second = 870 revs. per minute.

This motor is in the R. Simpson Co.'s store, running one of the elevators. For those who wish to go into this further, they are requested to consult Sylvanus P. Thompson or other good works on the subject.

The calculations are extremely interesting, and it can readily be proved that the maximum work that can be got out of a motor is when the current is one-half that which flows when the armature is standing still, and that the efficiency is one-half, or 50 per cent.

COMPARATIVE EFFICIENCY OF ILLUMINANTS.

Of the total energy supplied, a candle consumes 86 watts per candle; oil lamp, 57 watts; butterfly gas burner, 93 watts; incandescent lamp, 3.5 watts; arc lamp, .8 watt. Thus, if gas is used in a gas engine having an efficiency of 20 per cent., it will produce about five times more light from incandescent lamps than if burned direct in jets.

THE OILS OF THE ENGINE ROOM.*

OIL is the main factor in the reduction of that element of waste, friction, and in proportion as you apply oil of the proper kind and in the proper way, just so much do you economize in fuel, wear and tear, and consequently in the loss of power.

Oils are usually divided into two classes, drying and non-drying. To the latter class belong lubricating oils, which are the oils of the engine room. We will first consider the conditions under which the oils are applied. The first point that comes to our notice is that the oils are placed between two metal surfaces to keep them apart, and therefore the oils themselves sustain the pressure of the lever, at one end of which is the weight (which is the work of the machine) and the compounding power which is equal to the weight; we find, therefore, that the oil has to withstand an enormous pressure according to the kind of machine it is in. As we have observed, the oil is between two metal surfaces which are very close together, and the deduction would be that the oil should be quite free from hard particles which might abrade these two surfaces. Usually one surface is hard and the other soft, and were particles of a gritty nature allowed to pass into the oil, the two surfaces—which we will after this call the bearings—the consequence would be that they would become imbedded in the soft part and would cut the hard surface or the shaft. The idea which you will gather from these remarks so far is that oils should be clean.

We will now come to find that we have another condition which will be as important as the previous one. The oil is used at two different temperatures, a low and a high temperature, the first cold bearings first; these include nearly all bearings, there being but three or four hot bearings on one individual engine, and taking the shaftings, hangers and all other journals as parts of the machine, by far the larger proportion are cold bearings. The temperature of an engine room will average 70 degrees, and the bearing will be exposed from this down, in cases of shaft passing from one building to another, or in processes where the buildings are not heated to zero. It will here be apparent that oil must be useful at low temperatures. You are all aware that certain oils are solid at the freezing point of water; it would be plain to you that such a condition would prevent the oil moving to the point where it would be required even if the action of the parts would make it of use if it were in place. We must therefore require that oils should flow at the temperatures to which the bearings are exposed.

It is also required that oils should be stable at the highest temperature to which they will be exposed—allowing this to be 100 degrees, this being the temperature at the hanger level in a hot work room. Stable in that they will not evaporate and let the bearing go dry, which is called gumming. This is a characteristic of vegetable oils. It is also necessary that the oil should not turn rancid with the formation of acid and a consequent loss of lubricating quality. This is a condition which ensues with animal oils, also to some extent with vegetable oils.

We have up to this point considered the circumstances, conditions and requirements of the oils, and we have found that they should be clean, capable of withstanding pressure, workable at low temperatures, not volatile, non-drying, not rancid. Oils are divided under the following heads: Olive, cottonseed, linseed, palm, castor and fish oil.

(To be Continued)

A NEW COMBINATION OF STEAM ENGINE AND BOILER.

A NEW combination of steam engine and boiler is proposed by W. Schmidt, of Ballenstadt, Germany, the construction in this case being considered a valuable improvement on that class in which the cylinder of the engine is either partially or wholly arranged in the boiler. The objects aimed at and believed to be accomplished is for a steam boiler and engine capable of yielding a high effect, requiring repairs only at very long intervals and not necessitating continual attention. These advantages are attained by arranging the cylinder of the engine within the interior of the boiler, with the lower end projecting into the fire-box. The cylinder serves as a stay to the crown sheet. The engine is single-acting, and the valve is placed in the steam and water room of the boiler. Still further to secure efficient results by means of this arrangement, there are provided, in addition to the heating surface furnished by the fire-box, a number of drop tubes, which add very much to the steam generating capacity of the boiler.

* Paper read at open meeting of Hamilton No. 2, C.A.S.E., January 18th, 1898, by J. W. Williams, chemist for Winer & Co., wholesale druggists.

CORROSIVE AND SCALE-FORMING AGENTS IN BOILER FEED WATERS.

By Wm. Thompson.

[ARTICLE 2].

WHEN we understand what is taking place during the act of pitting, it becomes comparatively easy to suggest a remedy. What is required here is a substance on which the corrosive agent can exhaust itself; and probably the best remedy is a slight coating of lime scale, which can be easily obtained by the use of lime water or milk of lime.

This theory has not, however, been universally accepted as the true cause of pitting (although in the writer's opinion it appears very rational). The cause of this trouble has been attributed by many writers to electrolytic action set up between the impurities of the iron and the iron of the boiler itself, which, being electro-positive to the impurities, gradually disappears while the impurities remain to further the disintegrating action. In support of this theory it became a common practice to suspend zinc in boilers subject to pitting and corrosion, on the assumption that since zinc is chemically more powerful than iron, it would become electro-positive to the iron and thus protect the boiler against electrolytic action at the expense of its own metal. If such is the case, then it becomes very necessary for us to note what may be expected to take place when zinc is suspended in the boiler as suggested.

To get as clear an understanding as possible of this process, let us briefly illustrate what takes place in a voltaic cell, which is practically what we are converting our boiler into with zinc and shell as electrodes and water and its impurities as electrolytes. To this end let us examine the process known as electrolysis, taking for example a dilute solution of hydric chloride, subjected to decomposition by means of electrolysis in a glass vessel so that process may be noted. We find chlorine evolved at the positive pole and hydrogen at the negative pole, the gases being perfectly pure and unmixed. If, while the decomposition of the hydric chloride is rapidly proceeding, we examine the intervening liquid carefully, no apparent movement or disturbance of any kind can be perceived, and nothing in the shape of currents in the liquid or transfer of gas bodily from one pole to the other can be observed, and yet two portions of the hydric chloride separated by two to six inches are actually seen to evolve pure chlorine and pure hydrogen.

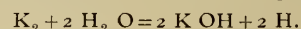
There seems but one method of explanation of this singular phenomenon, which is applicable to all similar cases of electrolytic decomposition, and that is to assume that each of the particles of hydric chloride intervening between the electrodes or poles, and by which electric current is conveyed, simultaneously suffer decomposition, the hydrogen travelling in one direction and the chlorine in the other. The neighboring elements being in close proximity to each other, unite to again form hydric chloride and destined to be again decomposed by a repetition of same change. Thus it is each particle of hydrogen may be made to travel in one direction by becoming successively united to each particle of chlorine between itself and the negative pole; and when it reaches the latter, finding no disengaged particle of chlorine for its reception it is rejected, so to speak, from the series and thrown off in a free state.

Exactly the same thing happens to the chlorine which is travelling in the opposite direction, consequently a succession of particles of hydrogen are thrown off at the negative pole and a corresponding succession of particles of chlorine at the positive. The power of the current is exerted with equal energy in every part of the liquid conductor, though its effects become manifest only at the terminals. The action is purely of an internal nature, and the metallic electrodes or terminals of the battery simply serve the purpose of completing the connection between the latter and the liquid to be decomposed.

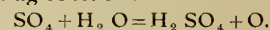
Like hydric chloride, all electrolytes, when acted upon by electricity, are split into two constituents, which pass in opposite directions. Substances of the one class, such as chlorine, iodine, oxygen, etc., are evolved at the positive pole, and those of the other class, such as the metals and hydrogen, at the negative pole. It is, though, important to remark that oxygen salts, such as the sulphates and nitrates, when acted upon by the current, do not divide into acid and basic oxide, but into a metal and compound substance or group of elements. Thus sulphate of copper (Cu SO_4) does not split into SO_3 and Cu O , but into metallic copper (Cu) and sulphuric acid ($\text{H}_2 \text{SO}_4$) dividing into the same compound and hydrogen. In a similar way it is seen that the part of the electrolyte passing to the negative pole

may be a compound consisting of several elements. An illustration of this change is the commonly used sal ammoniac ($\text{NH}_4 \text{Cl}$) which is decomposed in such a manner that the ammonium (NH_4) goes to the negative pole, when it is resolved into ammonia (NH_3), the pure hydrogen and the chlorine going to the positive pole.

We must, nevertheless, draw a distinct line between true and regular electrolysis and secondary decomposition brought about by the reaction of the bodies eliminated upon surrounding liquid or upon the substance of the electrodes. When, for example, potassium sulphate ($\text{K}_2 \text{SO}_4$) is electrolysed, hydrogen appears at the negative pole together with its equivalent quantity of potassium hydroxide (K OH), because the potassium which is evolved at the electrode immediately decomposes a portion of the water there present. The chemical reaction takes place as follows:



At the same time the sulphuric acid (SO_4) which passes to the positive pole takes up hydrogen by decomposing the surrounding water forming sulphuric acid ($\text{H}_2 \text{SO}_4$) and liberating oxygen according to following reaction:



In like manner the sulphuric acid itself is resolved by the current into hydrogen and sulphuric acid, which latter decomposes the water at the positive pole reproducing sulphuric acid and liberating oxygen just as if the water itself were directly decomposed by the current into hydrogen and oxygen. This explains a circumstance that was very puzzling to our early experimenters upon the chemical action of a voltaic battery. The true source of these compounds was traced by Davy in 1807, who showed very clearly that they proceeded from impurities in the water, or the vessel which contained it, or from surrounding air. He redistilled water at a temperature below boiling, and found when marble cells were used to contain the water intended for decomposition hydric chloride appeared at the negative pole and sodium at the positive, but derived from sodium chloride present in the marble as an impurity. This manifestly proves that water in a pure state is not an electrolyte and is incapable of conveying current, but is enabled to do so if even a trace of saline matter is present.

We have now, I hope, clearly expounded the principles of the voltaic cell. Now, let us consider its practical application for the purpose we have in view. Suppose we have a wire conducting an electrical current; cut this wire and place both ends in a cell containing water to which we have added some sulphuric acid to add to its conductivity. It will be observed that bubbles of gas are forming on the ends of the wires. These bubbles are simply hydrogen and oxygen obtained as already described. Let us now select for our poles, zinc and wrought iron, to get as nearly as possible the conditions existing within our boiler. If our zinc is pure no perceptible action will take place on immersion in the cold solution. We next immerse our wrought iron plate, and find chemical action is at once set up, hydrogen bubbles rising and metal gradually wasting away. Let us now connect the two wires from the source of electrical energy to the dry ends of our plates, and a complete change of conditions at once takes place. The hydrogen will still be seen to rise from the wrought iron plate, but the plate itself will cease to dissolve. But the zinc plate will gradually disappear, and just as long as any part of it remains in contact with the water and in electrical contact with the iron, the iron will be protected from decomposition at the expense of the zinc. We can now, I think, perceive clearly the reason for the gradual wasting away of the zinc or positive pole. As the water is decomposed by the passage of the current, the oxygen is attracted to the positive pole, and being practically electrolytic, oxygen or ozone attacks the metals, very actively and destructively, and we find them more or less rapidly wasting away.

We have now before us information to enable us to understand the action of zinc in boilers, and can readily see that zinc can only be successfully used where certain conditions pre-exist. We must first have some solution that makes a good electrolyte, and next see that contact between zinc and shell of boiler is electrically good; further, we must be sure that galvanic action is set up within the boiler. I think it has been amply proven in engineering practice that galvanic action is set up within the boiler due to many causes, such as difference in temperature in different parts of the boiler, thereby causing a current, and generating electricity due to friction; also galvanic action is set up between the different kinds of metal used in and about a boiler, such as composite fittings and steel shell, etc. It is also quite possible to create gal-

vanic action between different parts of the same boiler when a certain portion of the metal is homogeneous, while another is poorly made, due to bad iron, etc. In fact, galvanic action may be set up in a multitude of ways, and it is this very fact that makes the use of zinc in boilers, especially in fresh waters, rather to be condemned than approved, especially when action is not clearly understood. It has lately become a very common practice, especially in marine work, to purposely set up galvanic action within the boiler; by the aid of an external current, to prevent not only corrosion, but the formation of scale, and the system has met with a great deal of success, as it very properly would when conditions are favorable. Marine engineers are, however, exceptionally favored in this respect. Not only does their feed water contain a large quantity of saline matter, but also a certain proportion of free acid, making the solution within the boiler an excellent electrolyte; consequently they have only to see that contact between their zinc and iron electrodes is correct and galvanic action set up to secure good results.

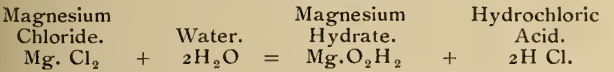
The first essential required is a thorough knowledge of action of zinc in boilers, and secondly, a knowledge of conditions pre-existing. Before leaving this subject I wish to point out to the reader that nothing but the purest zinc must be used. Ordinary commercial zinc contains many impurities, and especially must lead be absent. If lead is present it will be found after zinc has wasted away, and a new condition of things will exist; the shell of the boiler will become electro-positive and the lead negative, and the cure becomes worse than the disease.

GENERAL CORROSION.

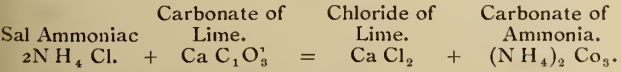
This form of corrosion is in some localities a very common one, and is a peculiarly difficult one to explain in a general way. It is largely due to the presence of free acids, which may be present in the feed water, or may exist as a result of the use of some of the vile nostrums sold as boiler compounds, prepared frequently by people who do not know the first requirements of the substance they sell, except that it will take off scale. When carbonates are absent, free sulphuric acid may be present, especially in mining districts, and chiefly derived from the oxidation of pyrites and sulphides. This acid is also often found in streams passing through manufacturing districts, owing to the refuse from dye works, galvanizing shops, chemical factories, etc., having been discharged into them.

Another fruitful source of free sulphuric acid is the use of kerosene, which is now so commonly used. Kerosene is produced by one of a series of distillations of petroleum, and in its first and crude state is a turbid liquid, having a strong odor and a bluish tinge. To remove these, the refineries give the kerosene a course of treatment with sulphuric acid. Part of this, together with impurities, precipitates as a heavy black sludge. The purified oil is next treated with caustic soda, to neutralize any free acid, and then washed with water. Like many other processes of a similar nature, work is not always well done, and free sulphuric acid remains in solution. The oil itself vaporizes very readily when in the boiler and passes off with the steam. The sulphuric acid being non-volatile, remains behind, and finally becomes sufficiently concentrated to attack the boiler, and corrosion sets in.

A very prolific source of corrosion is also caused by the presence of hydrochloric acid in the water. This is a very fruitful source of trouble in waters containing magnesium chloride in solution, and is often caused in waters containing other salts of magnesia by the use of compounds which reduce salts of magnesia to magnesium chloride. At all temperatures of present boiler practice, magnesium chloride decomposes in presence of water in accordance with following chemical equation:

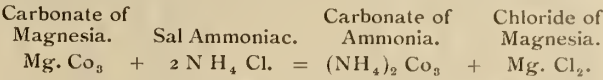


Reference has been made to the formation of magnesium chloride, and consequently the liberation of hydrochloric acid by the use of compound resolvents. A striking example of this is the practice of adding sal ammoniac, N H₄ Cl., to the feed water to dissolve carbonate of lime, the reaction in this case being:

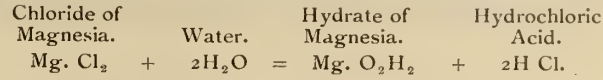


The final result is that a soluble salt added to a water containing an insoluble salt, the insoluble salt is rendered soluble, and consequently no precipitation takes place. Unfortunately, the reaction does not stop here; waters containing carbonate of lime invariably also contain carbonate of magnesia, and the following reaction is

set up between the sal ammoniac and the carbonate of magnesia:



This latter salt undergoes a secondary decomposition as follows:



The action of hydrochloric acid differs materially from the action of the sulphuric acid, owing to the fact that it volatilizes very readily, and as a vapor passes off with the steam; thus, not only will the boiler itself be attacked, but also the steam pipes, and even the engine. This acid, at temperatures higher than boiling, even in dilute solutions, attacks iron very readily, and is a fruitful source of corrosion and its companion troubles.

Vegetable acids, or properly speaking, organic acids, while of a feeble nature, still attack iron to some extent, and particularly since these acids are derived from waters usually taken from swamps containing a great deal of vegetable organic matter with very little lime salts. In cold climates the water is also apt to contain a considerable quantity of free oxygen, which adds materially to the corrosive action of the acids present. The presence of the slimy organic precipitate common to waters of this class seems to add to, rather than retard, the work of corrosion.

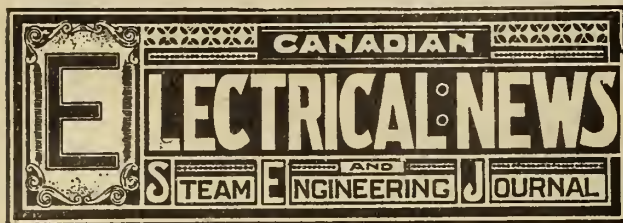
Whole chapters might be written on the best methods of treating troubles of this kind, but I consider the best advice is to consult some one thoroughly trained in this particular subject, who is not only able to suggest a remedy, but can determine accurately the nature and cause of trouble, and the slight expense incurred will never be regretted.

(To be Continued)

MOONLIGHT SCHEDULE FOR MARCH.

Day of Month.	Light.	Extinguish.	No. of Hours.
	H.M.	H.M.	H.M.
1....	P.M. 11.50	A.M. 5.40	5.50
2....	" 12.00	" 5.40	5.50
3....	A.M. 12.40	" 5.40	5.00
4....	" 1.50	" 5.40	3.50
5....	" 3.00	" 5.40	2.40
6....	No Light.	No Light.	.....
7....	No Light.	No Light.	.....
8....	No Light.	No Light.	.....
9....	No Light.	No Light.	.....
10....	P.M. 6.30	P.M. 9.50	3.20
11....	" 6.30	" 11.10	4.40
12....	" 6.30	A.M. 12.20	5.50
13....	" 6.30	" 1.20	6.50
14....	" 6.30	" 2.30	8.00
15....	" 6.30	" 3.30	9.00
16....	" 6.40	" 4.20	9.40
17....	" 6.40	" 5.00	10.20
18....	" 6.40	" 5.10	10.30
19....	" 6.40	" 5.10	10.30
20....	" 6.40	" 5.10	10.30
21....	" 6.50	" 5.10	10.20
22....	" 6.50	" 5.10	10.20
23....	" 7.00	" 5.10	10.10
24....	" 8.00	" 5.10	9.10
25....	" 9.10	" 5.10	8.00
26....	" 10.10	" 5.10	7.00
27....	" 11.10	" 5.10	6.00
28....	" 11.10	" 5.10	6.00
29....	" 11.50	" 5.10	5.20
30....	.....	" 5.10	4.30
31....	A.M. 12.40	.....	
Total.....			188.60

A civil engineer has been examining the feed water of boilers, and has come to the conclusion that the presence of an acid in a boiler can be accounted for in this manner: Internal corrosion is not only caused by the acids with which some canal, pit and other waters are impregnated, but is also due to the acidity resulting from the decomposition, by high temperatures in boilers, of chlorides of lime, magnesia and sodium, and of sulphates of lime and magnesia, the former sometimes developing hydrochloric and the latter sulphuric acid. If steps are not taken to neutralize these acids by introducing some substance for which they have a greater affinity than the material of the boilers, the latter becomes pitted or wasted more or less rapidly.



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Canadian Electrical Association.

In our next issue we will inform our readers fully as to the excellent work done by the Committee on Legislation of the Canadian Electrical Association, and the progress made toward securing such changes in the law as will place electric and gas companies on a more equitable footing than they at present occupy with respect to municipal lighting.

Cheap Power.

AN indication of the economical possibilities of an up-to-date steam plant for the generation of electricity is to be seen in the offer of the Toronto Electric Light Co. to supply electric power, ten horse power and over, ten hours per day, at 2 cents per h.p. per hour. Such an offer is calculated to induce close figuring on the part of projectors of long-distance power transmission schemes.

Gigantic Electrical Undertaking.

AN electrical undertaking which has heretofore been unequalled in magnitude is about to be carried out in New York, and is attracting world-wide attention. It is the conversion of the overhead railway from steam to electric power, which will involve an estimated outlay of at least seven million dollars. Four of the largest manufacturing companies, namely, the General Electric, Westinghouse, Walker and Sprague, are now figuring on the proposition, which is calling into requisition the skill of the most talented engineers in the country.

Electrical Apparatus for the Parliament Buildings.

MUCH unfavorable comment has been made upon the action of the Minister of Public Works in awarding the contract for lighting the Parliament Buildings at Ottawa without inviting tenders. At the last session of the Dominion Parliament an appropriation of \$75,000 was set aside for lighting the buildings by electricity and

increasing the fire protection. It was generally supposed that the usual course of publicly inviting tenders would be followed, and that all Canadian manufacturers of electrical apparatus would be given an opportunity of figuring on the work. The government, however, considered it wise to enter into a private contract for four Westinghouse 40 horse power electric motors and four Worthington fire pumps, and also for the necessary current to light the building throughout. In justification of the course pursued, the claim is made that by the agreement entered into a saving of several thousand dollars a year will be effected. It is difficult to understand just how this estimate is reached. Granting that current can be purchased more economically than it could be generated by a plant placed in the buildings, there seems no reason why tenders should not have been invited for such apparatus as was purchased. This method undoubtedly secures the best results and gives most general satisfaction.

Power for Street Railways.

It has been rumored for some time past that the Montreal Street Railway Company were considering the question of buying the necessary power for the operation of their system. This report was recently strengthened by an inspection of the Chambly power plant made by Messrs. F. S. Pearson, chief engineer of the Metropolitan Traction Company of New York; E. H. Keating, manager Toronto Street Railway, and F. L. Wanklyn, manager Montreal Street Railway. These engineers will, it is said, make a report to the directorate of the company, and upon this will depend future negotiations. The Montreal Street Railway Company at present generates its own power, using about 9,000 horse power per day. The cost of producing this power is estimated at \$42 per horse power, which represents an annual expenditure of over \$360,000, while, according to reports, the Chambly Manufacturing Company have offered to furnish the necessary power at \$32 per horse power. This would mean an annual saving of \$90,000. Granted that these figures are correct, the saving thus effected would very soon pay for the street railway plant now utilized, and which would have to be discarded or sold at a great reduction below first cost. It might, however, be found necessary to retain the plant as an auxiliary.

Some Important Experiments.

PROFESSORS Callender and Nicholson, of McGill University, Montreal, have been making some experiments in connection with the steam engine which promise to be of great practical value. They have presented to the English Institution of Civil Engineers a paper on the subject, which we hope to publish in our March issue. The object of the experiments was to ascertain the exact temperature of the steam in the cylinder at different points of the stroke, it having been known to change as much as 100 degrees Fahrenheit in one second. These changes were too rapid to permit of being recorded by mercury thermometers. Professor Callendar has, therefore, devised an electrical resistance thermometer, by means of which it is possible not only to ascertain the temperature at any point of the stroke, but to follow it exactly throughout its entire course. The thermometers are fixed both inside the cylinder walls and in the head of the piston, and as the latter is

carried up and down, continuous readings on the galvanometer can be observed. The professors are now continuing their experiments on the large compound engine in the Montreal Street Railway Company's power house, which is probably the largest engine in the world coupled to a single generator. This engine is said to be well adapted for test purposes on account of the very complete arrangements for steam-jacketing the various parts of the cylinders. Some valuable as well as interesting results may be expected.

Improved Conditions.

THE business outlook in Canada at this moment is most encouraging. The combination of a bountiful harvest with unusually high prices for agricultural products appears to be the greatest factor in bringing the return of prosperous conditions. The rich gold discoveries of the Klondyke have turned the eyes of the world towards Canada, and as a result the tide of immigration and of capital is beginning to flow into the Dominion. The period of more rapid advancement which Canadians have been looking and hoping for is undoubtedly at our doors. We should keep in mind the words of Shakespeare, "There is a tide in the affairs of men which, taken at the flood, leads on to fortune." This is true of nations as well as of individuals. Every advantage should be taken of the unusually favorable conditions now prevailing to push forward the development of the nation, its commerce and industries. Comparatively good progress was made by the electrical industries even during the recent period of depression, but a large number of projected undertakings could not be proceeded with owing to the difficulty of securing the required capital. It may fairly be anticipated that, with capital seeking investment, many of these enterprises will go forward to completion during the present year. The electric railway field is by no means fully occupied, but is capable of great extension. The city of Toronto might well be made the centre of a system of radial lines, which would make it the trade centre of a large and wealthy agricultural district. Electric railways intersecting the country in all directions, having facilities for the transportation of both passengers and freight, would be a most effectual check upon exorbitant freight and passenger charges by the two great steam railroad corporations. If this object is to be served, however, care must be taken to prevent the absorption of the electric by the steam roads. In the matter of electric power transmission Canada already stands in the very front rank, and we look for the utilization in the near future of many valuable water powers which are available for this purpose in all parts of the Dominion. Constant development and improvement is taking place in electric lighting, notwithstanding that only by the exercise of the greatest skill and economy can a reasonable return be secured from the capital invested.

A remarkable instance of the efficiency of roller bearings was recently made on a steel wheel weighing 130 pounds and 14 inches in diameter, which was speeded up to 10,000 revolutions per minute, and continued revolving one hour and a half after suddenly disconnecting the source of power. This was accomplished with absolutely no detriment to the bearing, when the plain bearing would have been ruined under such conditions.

THE RELATIONS BETWEEN THE CUSTOMER, CONSULTING ENGINEER AND THE ELECTRICAL MANUFACTURER.*

BY S. DANA GREENE.

THE subject which I have chosen for this paper is an eminently practical one, and I shall endeavor in my remarks to call attention to certain causes of friction which at present exist between the parties in interest, and to suggest certain remedies which may serve to bring about a better understanding and to lessen this friction, which is, in my opinion, entirely unnecessary.

In order to discuss intelligently present conditions, it is advisable to trace briefly the development of the electrical business, and to do this one need hardly go back more than a dozen years. At that time electric lighting was still an experiment (from the commercial standpoint), electric railroading had not begun, and electric power transmission was discussed as one of the possibilities of the future. Very few of our institutions of learning had established separate electrical courses, and such a thing as a consulting electrical engineer hardly existed in this country. The few men who had some theoretical knowledge were eagerly caught up by the manufacturing companies, who had difficulty to find men capable of solving the many pressing practical problems with which they were confronted when they began to sell electric machinery. Thus the development of a practical generator and incandescent lamp immediately created a demand for suitable conductors and materials for outside and inside wiring, safety devices, etc., as well as close regulating engines, proper station appliances and many other things which are to-day regarded as "standards" in the business. It was less than a dozen years ago that the first fireproof switchboard was installed in the Broadway Theatre. The specifications were drawn by a consulting engineer—a naval officer by the way—calling for a fireproof structure, and the manufacturer no doubt accepted the order thinking that he could use what had always been used before, viz., a wooden framework. In this he was mistaken, however, and after a year's wrangling a slate board was installed, much to the manufacturer's disgust, and at great expense to him. It is hardly necessary to say that this form of switchboard became standard immediately, and several years after, the manufacturer, happening to meet the naval officer, said to him, "Someone was a d—d fool about that switchboard, and you were not the man." I well remember when I left the navy to join the Sprague Company in June, 1887, I found that the technical force of the company consisted of Mr. Sprague, an ex-naval officer, and Lieut. Crosby, who had just left the army. Upon explaining to the former how modest was my store of knowledge on the subject of "electric street railways," he at once assured me by saying that we were all in about the same boat! My opportunity came sooner than I expected when, about July 1st, I was charged with the execution of a contract for the equipment of a 40-car road in Richmond, Va., which, under the terms of the contract, was to be in full and complete operation on the first of the following October.

Doubtless most of those present to-night can recall the remarkable growth of electric lighting and railway work during the next five years, from 1887 to 1892—a growth that can fairly be called tropical. Plants sprang up in nearly every city and town in the country, and

manufacturers sprang up with equal rapidity. There seemed to be unlimited money ready to invest in electrical enterprises, and the anticipated profits were such as to make the old established manufacturing industries seem very poor investments. During this period, which may be called the "forced expansion period," purchasers usually had to take what they could get, and consulting engineers were few and far between. Specifications for apparatus or installations, when there were any, were generally prepared by the manufacturer, and the purchaser rarely knew whether they had been fulfilled or not. By the close of this period, however, the colleges and technical schools began to turn out men who had taken special courses in electricity and who naturally looked for a chance to make an honest living. The first great demand of the manufacturing companies for technical assistants having been satisfied, many of these young men found their way into local operating companies, or else established themselves as consulting or contracting engineers, in which positions they found plenty of work, for by this time the imperfection in the earlier installations and types of apparatus had become plainly evident to the purchaser as well as to the manufacturer, and there was a general demand for better workmanship and more rigid requirements in installation. It may be here noted that much of the "anticipated profit" of the business, both of the operating and manufacturing companies, was spent subsequently in making good these early defects, and while the business as a whole profited largely by this reconstruction process, it naturally dampened the enthusiasm of the early investors.

In 1893 came the panic, and for the past four years there has been a wonderful record of savings and economies, both in electrical manufacturing and operating companies, as well as a great improvement in quality of product. It has been, in fact, the "economic and reconstruction period." The operating companies have learned that they, too, are manufacturers of a product, electricity; and as these hard times have forced down the price of their product, they, like the manufacturers of apparatus, have to keep their heads above water and their companies out of receivers' hands by the introduction of more economical and improved methods of manufacture and of administration. During the past year there has been a marked improvement in the electrical business; it is to be hoped that this improvement is permanent, and that the past four years of retrenchment and economy have paved the way for a normal and steady growth on conservative lines—in other words, for a period of "natural expansion." The business to-day is on much the same basis as in other industries, where prices are close, competition keen, and where a better article is furnished for less money than ever before.

The manufacturers of apparatus and the manufacturers of current are dependent upon each other to a large extent, and their relations should be close and friendly. The consulting engineer, as in other engineering trades, is a necessary and proper connecting link between the two, and I can say frankly that I believe he has a proper and permanent field of usefulness. Broadly speaking, his function is to see that his client who buys apparatus and installs it selects, first, that system best suited to his particular local conditions, and then, in purchasing, secures the best—not necessarily the most—for his money. It is equally the duty of the consulting engineer

* Paper read before the New York Electrical Society, January 21, 1898.

to learn what the manufacturer can reasonably be called upon to make, to consult with him freely and to obtain the benefit of his experience; to give him credit for work well done, and to insist that bad work shall be promptly corrected. Many consulting engineers, especially those who have recently commenced practice, seem to think that it is improper for them to consult with the manufacturer, or to examine his plant, or to ask him for information or advice. Their idea seems to be that, by so doing, they may be accused of partiality or undue bias, or with lack of proper care for the interests of the purchaser; or they may feel that it is derogatory to their own dignity as independent engineers. The inevitable result is that specifications often contain provisions which are a source of annoyance and expense to the manufacturer and purchaser alike, and which have no compensating advantages from either the engineering or commercial standpoint. In fact, some of these provisions are impossible or impracticable of fulfillment; and in such cases the honest manufacturer who wishes to meet the specifications and guarantees required finds himself forced to ask the engineer or the purchaser (sometimes both) to modify them. This is a proceeding which is always difficult and delicate to undertake, and often results in friction and trouble for all concerned. I am satisfied that if every consulting engineer would take advantage of opportunities as they occur, to visit manufacturing establishments, see the work there in progress and confer with the engineers, he would find himself well repaid for the visit, and his own work and practice benefitted thereby. I am equally satisfied that no reputable manufacturing establishment would refuse admittance, but on the contrary would welcome such visits as beneficial to both parties. The day of mysterious methods of manufacture, carried on behind closed doors, is passed in the electrical business, and I appeal with confidence for an indorsement of the opinions just expressed, to those consulting engineers who have already tried the plan suggested. I have said that I thought the engineer would find himself repaid by such visits. I think, also, that he will find himself in a better position to advise his client intelligently. A purchaser usually knows little or nothing of the relative technical merits of apparatus, and his final decision is governed largely by price and by paper statements and guarantees, which may mean much or little. The consulting engineer who has seen the apparatus in process of manufacture can advise not only as to whether the various bids comply with the specifications, but also what make or makes of apparatus are, from their design, construction and factory inspection and test, most likely to give the least trouble and expense in continuous service.

Some engineers seem to measure their value to the purchaser by the length of their specifications, and some of these formidable documents strike terror to the heart of a busy man confronted by a desk full of mail. The specifications not only specify what the conditions of service are, what apparatus is required and what tests shall be applied to it for acceptance, all of which are quite proper, but also how it shall be built, which is another matter. The electrical manufacturers of this country, following the admirable precedent which has given American manufactured products (particularly machinery) a world-wide reputation, have endeavored to establish standard lines of apparatus, whenever the permanency of type and the size of the demand warrant it.

This practice not only tends to reduce cost (and with it price), but also enables the purchaser to secure quickly and at a minimum of expense duplicate parts which are really duplicates, and which can be fitted without the aid of a skilled mechanic. It is the American system of standard lines of machinery and interchangeability of parts, which has stood the test of time and which holds its own against all competitors. This system, however, is possible only where the same article is manufactured in quantity, since the expense of designs, drawings and patterns, special tools, jigs, dies, etc., is prohibitive unless spread over a large production. On the other hand, if special apparatus is required it means a relatively large expense for these items, which cannot be charged to a standard product, and which thus constitutes a handicap both to the manufacturer and the purchaser. A machine is "standardized" only after long experience, both in manufacture and service, and other manufacturers (the builders of engines, trucks, etc.) as well as the users, are invariably consulted before such standardization. It would appear to be to the interest of both seller and buyer to use such standard machines wherever and whenever possible; and yet it seems to be a fact that the demand for special machines is increasing, rather than decreasing, as apparatus becomes more generally standardized. To prove this I can cite the experience for the past year of one manufacturing company with which I am familiar. During this period the designing engineers were called upon for estimates on special apparatus as follows:

Direct current:	
Number of estimates	300
Number of kilowatts of apparatus involved	31,000
Alternating current:	
Number of estimates	300
Number of kilowatts of apparatus involved	131,200

These estimates were all embodied in formal propositions. Besides these there were between two and three times as many preliminary estimates required to answer inquiries of customers, which the engineers had to prepare.

This was in addition to their regular work on standard lines of apparatus, of which there are over thirty. Some of this work was undoubtedly due to new developments in the business and to new methods and inventions, a condition which, although unfortunate from the manufacturing standpoint, must exist for many years to come; but a great deal of it was also due to the fact that specifications call for special apparatus, or methods of construction, where standard apparatus and methods would do equally well. This experience I find is common among electrical manufacturers, and I attribute it largely to lack of touch between the manufacturer and the engineer drawing the specifications, whether he be regularly employed by the purchaser, or retained in an advisory capacity. Let the engineer see more of the manufacturer and his work, and let him hold the latter responsible for results, as determined by proper tests, leaving the details of construction where they belong—in the manufacturer's hands.

G. T. Simpson, electrical supplies, Hamilton, is reported to have assigned to J. W. Vandyke.

Messrs. Hodge & Walley, of Sherbrooke, Que., want tenders for the supply of 50,000 electric railway ties.

The Canadian General Electric Company recently issued a writ against the Street Railway Company of Brantford for \$230,000, on an old construction account, and judgment has been secured for the amount and placed in the sheriff's hands for execution.

SPARKS.

The British Columbia Oil Co., Vancouver, B. C., has been incorporated.

An electric light plant has been put in the St. Francis Xavier College, Halifax.

An electric light plant has been installed in a new summer hotel at Gore's Landing, Ont.

The Bushnell Oil Co., at Sarnia, Ont., now have their works lighted by a private electric light plant.

The Hull Electric Company have placed an order for five new summer cars with the Ottawa Car Company.

The Mountain Tramway & Electric Co., of Victoria, B. C., is seeking incorporation. The C. P. R. is interested.

The capital stock of the Yarmouth Amalgamated Telephone Company has been increased from \$10,000 to \$25,000.

The toboggan slide constructed by the Hull & Aylmer Electric Railway Company, at Aylmer, Que., is said to be well patronized.

The Welland Aqueduct Power Company has been organized, with a capital stock of \$24,000, to supply electricity for light, heat and power.

The C. O'Dell Electric Light Company, of Annapolis, N. S., is seeking incorporation. The company consists of Carman O'Dell, Jos. Foster, and others.

J. W. Robbins, one of the engineers at Beatty's foundry, Welland, Ont., died suddenly of heart failure shortly after returning from his work on Tuesday, December 4th.

The city engineer of Halifax, N. S., has been making surveys with a view of ascertaining where a sufficient water power can be obtained for operating an electric light plant.

The electric light company of St. Stephen, N. B., has purchased a 275 h. p. engine and three 100 h. p. boilers. This plant will be utilized upon the failure of the water power.

The Hamilton city council have resolved to engage an expert to examine the boilers at the city hall, with a view to putting in such apparatus as will reduce the consumption of fuel.

The Taylor Hydraulic Air Compressing Company, of Montreal, are installing a 500 h. p. plant at Ainsworth, B. C. The power is to be distributed to mines within a radius of five miles.

The taxpayers of Barrie, Ont., have voted in favor of purchasing the waterworks by arbitration. It is thought that an agitation for municipal control of electric lighting will follow this movement.

Acetylene, it is said, can be neither manufactured nor sold in Great Britain now save by express permission of the Home Secretary, the prohibition being made in a recent order-in-Council.

Messrs. John Starr, Son & Co. have lately equipped an electric light station at Antigonish for Messrs. MacCurdy & Co., of that town, and are now fitting up the light in a number of stores and houses.

The Massey Station Telephone Company propose to construct a telephone line from Spanish Station to Spanish Mills, Ont. Henry L. Glover and T. J. Millen, of Massey Station, are interested.

A company has been formed at Maniwaki, Que., for the purpose of supplying electric light. The directors are: Messrs. Chas. Logue, J. P. Trambley, Dr. Mulligan and Rev. Father Laporte.

The National Carbon Company, of Cleveland, Ohio, manufacturers of carbons and battery cells, have favored us with a copy of their calendar for 1898, which contains also the moonlight schedule for the year.

Doran's new hotel at Windsor, now nearly completed, is being fitted up by John Starr, Son & Co. with an entire outfit of electric light wirings and fittings, as well as electric annunciators and bells and speaking tubes.

The Montreal Belt Line Railway have established a freight office at Moreau street, Hochelaga, for transportation purposes. This is likely to prove a great accommodation to farmers and others shipping produce to the Montreal market.

The Bell Telephone Company of Canada has announced the connection of its system of long distance lines with that of the American Telegraph and Telephone Company and other telephone companies in the United States, thus establishing telephone

connections with Boston, Portland, New York and intermediate points.

It is reported that an effort will be made at the coming session of the Manitoba legislature to remove from the municipal act the clause which prevents the citizens of Winnipeg from voting on a Sunday street car by-law without the consent of the legislature.

The Berlin Telegraph of recent date says: The extension of the Galt and Preston Electric Railway to Berlin is likely soon to be an accomplished fact. Mr. Todd, the president, states that the work on the proposed extension will be commenced with the least possible delay.

McLaughlin & McDiarmid, of Lindsay, Ont., have given notice of application for the incorporation of the Tamagamingue Railway Company, to construct a steam or electric railway from a point on the C. P. R. in the townships of Springer, Caldwell or Kirkpatrick, to some point on Lake Tamagamingue.

The Electric Storage Battery Co., of Philadelphia, has just closed a contract with the Chicago Edison Company for a storage battery plant with a capacity of 7,436,800 watt hours. This will be the largest battery installation ever made. The contract includes switchboard and all the auxiliary apparatus, and will be completed in March, 1898.

Mr. D. A. Starr, manager of the Cornwall Electric Railway Company, submitted to the town Council of Peterboro', Ont., at its last meeting, a scheme for the construction of an electric railway from that town to Chemong and Lakefield. The company propose to lease the Chemong and Lakefield lines from the G. T. R., convert them into electric roads, and take over the freight business. The cost is roughly estimated at \$350,000.

Dr. E. J. Edgar, of North Hatley, has formed a partnership with W. O. Roy, of Montreal. They have acquired a water power on the Massawippi river, a little below the village of that name, and purpose furnishing electric light and power to North Hatley, Eustis and Waterville. A contract has been made with the Jenckes Machine Co., of Sherbrooke, Que., for developing the power, and the whole plant will be put in at once.

John Starr, Son & Co., Ltd., Halifax, are now fitting up the St. Mary's Cathedral with a system of electric lighting which is said to be the most perfect of any hitherto installed in Canada. The wires, which have double insulation, are enclosed throughout in enamelled steel tubing, and the fittings are most elaborate. When completed this, with the decorations and artistic paintings lately finished, will make St. Mary's one of the handsomest church edifices in Canada.

In his inaugural address to the City Council of London, Mayor-elect Wilson stated that as the contract for electric street lighting would expire during the year 1899, he considered it expedient to secure all information possible on this question with a view of submitting to the ratepayers a by-law to provide for the corporation undertaking the work of furnishing its own light. In his opinion a committee should also be appointed to report on the advisability or otherwise of renewing the Bell Telephone Company's franchise.

The Edison & Swan United Electric Light Company, of London, Eng., are introducing a new high efficiency incandescent lamp, which takes $2\frac{3}{4}$ watts per candle, and has a practically constant efficiency and light during its whole life of between 400 and 500 hours. In short, the "smashing" point is said to be never reached with this lamp, as the filament ruptures before the light has sensibly diminished. At present the new lamps are made only in the 16 candle-power size, but the other standard sizes will shortly be put on the market.

Mr. W. Hawley, who is interested in the application of electrical power to canal transportation, states that electricity will be introduced as the motive power upon all the canals of the state of New York, the Champlain canal to be the first to be equipped. At the next meeting of the Board of Directors of his company he will recommend the offer of a prize of \$25,000 for the best plan submitted for the utilization of an electric current to the propulsion of the canal boat. The electric current is to be transmitted in armoured cables in the ground along the canal lands.

The Crow's Nest Pass Coal Company is said to have given out orders for electrical coal mining machinery in the cities of Montreal, Toronto and elsewhere, to the value of \$100,000, while the company will also erect about fifty beehive coke ovens at Coal Creek for the purpose of supplying the article to the proposed smelter at Robson, B. C. Mr. Blackmore, chief manager of the company, has visited the leading mining centres in the

United States and Canada, with the result that the most improved electric coal cutting machinery will be started in the Pass mines.

The annual meeting of the Montreal Telegraph Company was held in the city of Montreal on the 13th ultimo. The annual report presented showed assets of \$2,263,030 and an excess over shareholders' capital of \$151,823.85. The contingent fund was stated to be \$70,869.11, and a resolution was passed that when the contingent fund reached such a figure that it would yield an annual revenue of \$5,000, then this amount should be divided among the shareholders. A dividend of \$40,000 was declared, and directors elected as follows: Andrew Allen, president, Hector Makenzie, Jesse Joseph, William Wainwright, Henry Archibald, Wm. J. Withall and Hugh. A. Allan.

The power house at St. Henri, Que., erected about five years ago by the Citizens' Light and Power Co., but recently purchased by the Lachine Rapids Hydraulic and Land Co., was totally destroyed by fire last week. It was a one-story brick building 125 feet long by 40 feet in depth, with boiler house in the rear. Through this building the current of the Lachine Rapids Hydraulic and Land Company was distributed to the various suburbs and to the city. The machinery included nine arc light machines, three incandescent machines, motors, exciters, engines and boilers, the whole being valued at \$100,000. No decision as to rebuilding has as yet been announced.

A dispatch from New York states that one of the most remarkable conversations on record recently took place in that city. It was carried on over a telephone wire. At one end of the wire was Captain Charles Jacques, superintendent of the Holland Submarine Boat Company, in the New York office of that concern. At the other end of the wire sat Simon Lake, in the cabin of the submarine boat Argonaut, eight miles out in Baltimore harbor and sixty-five feet under water. A fairly stiff gale was blowing up above, but Mr. Lake's wonderful craft crawled along steadily on its submarine way, paying out its cable as it went, and Mr. Lake's voice could be heard in New York just as clearly as if the speaker was on dry land.

An electric horn has just been placed upon the market which is capable of making a prodigious noise, sounding much like a marine fog horn. This electric horn is the invention of Mr. A. Trudeau, of Ottawa. The need of a horn of this kind suggested itself to the inventor after the late disastrous fire at the Ottawa College, where a serious calamity might have taken place had the fire occurred at night. These electric horns, of a specified size, may be utilized as a morning signal or a fire alarm for waking pupils in the dormitories of scholastic institutions, or for any other purpose where a whistle might be used where there is an electric current available. The horns can be placed in different parts of a building and all set tooting at once by turning on the current.

In order to ascertain whether higher voltages could be commercially employed, the high tension plant at Utah was experimentally run for a couple of days at the extraordinary high voltage of 30,000 volts. The length of the line was 73 miles, and the test lasted 72 hours, during the most trying climatic conditions, comprising heavy rain and severe lightning storms, during which the lightning arresters discharged repeatedly, but without causing a flickering in the light circuits. The line runs normally at 15,000 volts, but the transformers were connected up to give 30,000. No trouble in the insulation was experienced. Over 1000 horse power was delivered over the 73-mile line with a loss of but less than ten per cent., including the transformers at both ends.

According to newspaper reports an important discovery was made by the Bell Telephone Company while testing wires in the city of St. Louis, Mo. It is claimed that the electric current operating street cars can be taken from the earth into which it passes from the rails, and used again for light and power without the use of special electrical machinery. No dynamos and converters are necessary. General Manager Durant, of the Bell Company, said: "That the current from the street car ground wires remains in the earth, and travels underground, we have demonstrated beyond a doubt, and we are certain this force can be used again. We find that a single wire with the simplest kind of a connection will suffice to produce light from this earth current. I can see no reason why the current could not be carried through motors and dynamos in the same way. If the actual current as it comes from the earth were not sufficient it could first be gathered into storage batteries and thus intensified."

PERSONAL.

Mr. Wm. Kennedy, a well known engineer of Kingston, Ont., died in that city on the 27th ultimo, of pneumonia, at the age of 61 years.

Upon the occasion of his recent marriage, Mr. A. Lafebvre, of the Comptroller's staff of the Montreal Street Railway, was waited upon by a large number of confreres and presented with a complimentary address and well filled purse.

The friends of Mr. George C. Robb, chief engineer of the Boiler Inspection & Insurance Co., will regret to learn that he has been indisposed for some time past as the result of an accident just before Christmas. Mr. Robb was rendered unconscious by a fall on an ice covered sidewalk, and is still suffering from the effects.

We are pleased to announce that Mr. J. A. Kammerer is now believed to be on the road to recovery. His illness, referred to in our last issue, has been of a most critical nature, and until about one week ago his recovery was somewhat doubtful. It will require several months to entirely overcome the ravages of the disease and regain his former health.

While on a visit to Hamilton recently, Mr. John Knapman, manager of the Bell Telephone Company at Peterboro', Ont., was being shown through a large warehouse, when he stepped on the false flooring of the elevator shaft, which gave way, precipitating him to the basement, a distance of 40 feet. Mr. Knapman was badly shaken up, but no bones were broken. His companion, Mr. Peter Hamilton, of the Peter Hamilton Manufacturing Co., received injuries from which he died in the hospital a few hours later.

LEGAL.

The Court of Review has confirmed the judgment of the Superior Court in the case of Richmond County Electric Company vs. Sherbrooke Telephone Co. The plaintiffs claimed that the defendant company erected poles in the town of Richmond for their telephone business, and strung wires thereon across and about one foot above plaintiff's wires. The plaintiffs alleged that the defendants allowed their wires to remain in dangerous proximity to plaintiff's wires, and that defendant's wires had sagged and come in contact with those of the plaintiff, producing a short dead circuit, by which plaintiff's dynamo was wrecked and other damage caused. The Electric Light Company were awarded damages of \$218.

WALLACE VS. CITY OF OTTAWA.—Judgment on appeal by plaintiff from judgment of Meredith, J., at the trial at Ottawa, dismissing the action which was brought against the city corporation and the Ottawa Electric Street Railway Company for damages for injuries sustained by plaintiff by reason of the alleged negligence of one or other or both of defendants on the evening of the 7th December, 1896, whereby plaintiff was overtaken and run into by a tramway car in Sparks street, in the city of Ottawa, there being a very narrow passage for foot travelers between a fence erected outside the sidewalk, where there had been a fire, and a tramway line and an obstruction on the passage, and no warning having been given of the approach of a car. Plaintiff contended that there was negligence of both defendants, no contributory negligence on the part of plaintiff, and abundant notice to defendants of the condition of the roadway, etc. The learned judge, while dismissing the action, assessed the plaintiff's damages at \$350, and directed a reference as to damages for loss of business, etc., in the event of an appellate court finding negligence proved. Appeal dismissed with costs.

HE KNEW IT WAS HER.

MR. and Mrs. J. came to town the other day, says a Louisville paper. The madam is a large, muscular-looking woman, and is evidently the boss of the ranch, while Mr. J. is a cowed, effeminate-looking creature, who seems to be afraid when the madam is around. While Mrs. J. went into Goldnamer's to do some shopping, the little man slipped off to Bell's to get a drink. While he was down there he heard the telephone ring and enquired what it was. The mysteries of the instrument were explained, and Mr. Bell offered to call up his wife at Goldnamer's and let him talk to her. This seemed to please him very much, but just as he got the trumpet to his ear the lightning struck the wire and knocked him down. Staggering to his feet he said, "That's her; it sounds just her."

Rev. John Wilson, of Fitzroy Harbor, Ont., in renewing his subscription, writes: "Although I take several New York electrical journals, I do not like to be without the ELECTRICAL NEWS."

EDUCATIONAL DEPARTMENT

INTRODUCTORY

After mature deliberation the publisher of this journal has decided to devote a certain amount of space each month to what may be termed an Educational Department, wherein both mechanical and electrical formula and mathematical problems will be discussed, illustrated, and as far as possible rule and example given. At the request of the editor, I have with pleasure undertaken to contribute to this department regularly each month, and before discussing actual mathematical problems, wish to briefly introduce the subject at issue.

The primary object of this department is chiefly to increase the value of an already valuable paper, by placing in the hands of every engineer who has any knowledge of the rudimentary principles of mathematics, such matter as will enable him by a little study to master the most intricate mechanical and electrical formula. Many of our most valuable engineering works and publications from time to time contain formula that is in many cases but vaguely understood, and very often entirely misunderstood, thus rendering an otherwise valuable work practically valueless to the reader.

Just at what particular point our calculations should commence became a matter of serious thought, and past experience had to be carefully considered, bearing in mind the fact that there are many really good engineers whose early education has, through force of circumstances, been deficient, and many others who, through lack of opportunity, have not been able to review their early education for years. Knowing by observation and experience the great necessity of having a thorough elementary education before attempting to digest and calculate problems, and the almost utter impossibility of the student arriving at a satisfactory conclusion of his studies without a thorough knowledge of the principle of mathematics involved, I have decided to commence at a point and carry out the programme outlined in this journal—commencing at the foundation and advancing by easy stages until the principles underlying the most obtuse and difficult formula can be readily explained and easily understood. The advantages to be derived from an education of this kind, coupled with practical mechanical ability, is too well understood to require comment.

The programme which has been outlined for the succeeding nine months will embrace:

DECIMAL FRACTIONS—Definitions and explanation of principles of, and method of reduction to common fractions, and vice versa.

SQUARE AND CIRCULAR MEASURE—Definition and explanation and practical demonstrations of.

CUBICAL AND CYLINDRICAL MEASUREMENTS—Definitions and explanations of, with practical hints.

SQUARE AND CUBE ROOT—Definitions and explanations of.

SAFETY VALVE CALCULATIONS—(Spring and Lever Types)—Principles of, with practical demonstrations.

BOILER CONSTRUCTION—Stays, rivets, joints and seams, iron and steel plate—strength of, with formula and practical demonstrations.

It is not the intention to fill these columns with a mass of figures hastily compiled without reference to any particular object; on the contrary, every problem will be carefully thought out, and only such information given as will be of use to you, and an effort will be made, based on experience and a knowledge of the requirements, to make his series of tests complete in every particular.

WM. THOMPSON.

[ARTICLE X.]

DROP IN POTENTIAL AND SIZE OF LEADS FOR MULTIPLE ARC CONNECTIONS.

SUBSIDIARY leads or branch leads are taken from larger sized mains of constant E.M.F., or from terminals of generators with constant E.M.F. to supply current to one or more lamps, motors or other appliances requiring a constant E.M.F.

There is a drop of potential in the leads to be provided for so that the appliances may have to work at a reduced E.M.F. The E.M.F. of the leads is known, and the required E.M.F. of the appliance to be supplied with current, also its resistance, and a rule is required to calculate the size of wire in the lead to secure proper results.

The resistance of the leads supplying any lamp or appliance for a desired drop within the leads is equal to the reciprocal of the current of the lamp or appliance multiplied by the desired drop in potential expressed as volts. This principle is based on the fact that the drop in potential in portions of circuits varies with the resistance.

Example 10: A 110-volt lamp having a resistance of 220 ohms is to be placed 50 feet distant from a main having a constant E.M.F. of 115 volts. What must be the resistance of the line to maintain a constant E.M.F. of 110 volts at the lamp?

The lamp current is found by the formula:

$$C = \frac{E}{R} = \frac{110}{220} = .5, \text{ or } \frac{1}{2} \text{ ampere.}$$

The reciprocal of the current then is $\frac{1}{.5}$. This multiplied by desired drop 5 volts = $\frac{1}{.5} \times 5 = 10$ ohms, required resistance of leads.

For two or more lamps in parallel similar rules are applied.

In this case the E.M.F. of the terminals or main leads, the factors of the lamps, and their distance from the point of connection with the main leads require, to be given.

Example 11: A pair of subsidiary leads are to be run a distance of 150 feet from main leads, and to carry current for ten 50-volt lamps having a resistance of 100 ohms. The main leads have a constant E.M.F. of 55 volts. What is the resistance required in subsidiary leads, and what size of wire B & S gauge?

The combined R of lamps is found by formula:

$$R = \frac{R}{N}$$

Then $\frac{100}{10} = 10$ ohms, combined resistance of 10 - 100 ohm lamps in parallel, $\frac{10}{5} = 2$ amperes current to be supplied to lamps. The reciprocal of $5 = \frac{1}{5} \times 5 = 1$ ohm resistance required by line. Length of lead 150 ft. $\times 2 = 300$ ft., total length of line. Required resistance 1 ohm $\div 300 = .0033$ ohms per foot, equivalent to No. 14 gauge wire as per table.

Or this may be worked out on the principle that the resistance of the leads is equivalent to the combined resistance of the lamps multiplied by the percentage of drop and divided by 100 minus the percentage of drop; which we can express in formula thus, using x as representing the required quantity:

$$x = \frac{R \times \%}{100 - \%}$$

The percentage of drop is found by dividing required drop in E.M.F. by initial E.M.F. on mains, and $\frac{5}{55} = 9\%$. The required resistance of the leads then is $\frac{10}{100 - 9} = 1$ ohm, required R of lamps.

$$\frac{10 \times 9}{100 - 9} = \frac{90}{90} = 1 \text{ ohm, required R of leads.}$$

STRENGTH OF BOILERS.

The Steamboat Inspection Act, 1882, ss. 4, provides "that the areas of diagonal stays are found in the following manner:"

Find the area of a direct stay needed to support the surface, multiply this area by the length of the diagonal stay, and divide the product by the length of a line drawn at right angles to the surface supported to the end of the diagonal stay; the quotient will be the area of the diagonal stay required.

Example: Find the area required in a diagonal stay supporting 1 square foot of surface, boiler pressure being 75 pounds per square inch, length of diagonal stay 12 feet and length of line 9 feet, stress allowable per square inch of section on direct stay being 6,000 pounds.

12

12

144 square inches surface supported.

75

720

1008

10800 total stress on direct stay.

$10,800 \div 6,000 = 1.71$ square inches, required area of direct stay.

1.71 area of direct stay.

12 length of diagonal stay.

$20.52 = 1.71 \times 12 \div 9$ length of line = 2.27 square

inches, required area of diagonal stay.

When the tops of combustion boxes or other parts of a boiler are supported by solid rectangular girders, the following formula may be used for the purpose of finding the working pressure to be allowed on the girders, assuming that they are not subjected to a temperature greater than that of the steam and are supported by hanging stays.

Formula:

$$\frac{C \times d^2 \times T}{(W - P) D \times L} = \text{working pressure.}$$

Where W = width of combustion box in inches,

P = pitch of supporting bolts in inches,

D = distance between the girders from centre to centre in inches,

L = length of girder in feet,

d = depth of girder in inches,

T = thickness of girder in inches,

C = 500 when girder is fitted with one supporting bolt,

C = 750 when fitted with two or three,

C = 850 when fitted with four.

The working pressure for the supporting bolts and plate between them is determined by rules for ordinary stays already referred to.

The pressure allowed on plates forming flat surfaces is found by the following formula:

$$\frac{C \times (T + 1)^2}{S - 6} = \text{working pressure per square inch.}$$

Where T = thickness of plate in sixteenths of an inch,

S = surface supported in square inches,

C = 100; but when the plates are exposed to the impact of heat or flame, and steam only is in contact with the plates on the opposite side, C must be reduced to 50.

Example: Find safe working pressure of a flat-bottomed boiler whose stays are pitched 15 inches apart and thickness of plate is $\frac{1}{2}$ inch.

$$\frac{C+(T+1)^2}{S-6} = \frac{100 \times (8+1)^2}{225-6} = \frac{8100}{219} = 37 \text{ lbs. safe working pressure.}$$

To find required thickness of plate we must reconstruct the formula :

$$\frac{S-6 \times P}{C} = (T+1)^2 \text{ and } \sqrt{T+1} = T.$$

Example : Find the required thickness of plate for a flat-bottomed boiler, whose stays are pitched 12 inches apart and steam pressure is 50 pounds per square inch, and depth of water in boiler is 7 feet. Also, what must be the diameter of stays if they are not allowed to carry more than 6,000 pounds per square inch of section ?

$$\text{Pressure due to water} = .433 \times 7 = 3.031 \text{ lbs.}$$

$$\text{Pressure due to steam} = 50.$$

$$\text{Total pressure per square inch} = 53 \text{ lbs.}$$

Then

$$\frac{S-6 \times P}{C} = \frac{(144-6) \times 53}{100} = \frac{7314}{100} = 73.14.$$

And $\sqrt{73.14} = 8.55$. $8.55 - 1 = 7.55$ or $\frac{15}{2}$, required thickness of plate in sixteenths or thirty-seconds of an inch.

Stays are pitched 12 inches apart, and therefore must support a surface of $12 \times 12 = 144$ square inches.

$$144 \times 53 = 7,632, \text{ total weight each stay is called upon to support.}$$

$$7,632 \div 6,000 \text{ stress allowed per square inch of section of stay} = 1.272 \text{ square inches, required area of stay.}$$

$$\sqrt{1.272 \div .7854} = 1.25 \text{ (nearly), required diameter of stay.}$$

It sometimes occurs that the stays of a boiler are to be fixed with cottars, and it is necessary to know what size the end of the stay must be swelled to so as to have the same strength as the stay. For this purpose the following formula is used :

$$D = \left(1 + \frac{.08}{N} + \frac{.4}{\sqrt{N}} \right) d$$

Where d=diameter of stay in inches.

D=increased diameter.

N=depth of cottar in terms of its width ; that is, if cottar is $\frac{1}{2}$ an inch wide and $1\frac{1}{2}$ inches deep, N would be 3, since depth of cottar is 3 times the width.

Example : The stays of a boiler are to be fixed with cottars $\frac{1}{2}$ an inch thick and 2 inches thick, the diameter of stay being $1\frac{1}{2}$ inches, what size must the end be made so as to have uniform strength with stay ?

$$D = \left(1 + \frac{.08}{4} + \frac{.4}{\sqrt{4}} \right) \times 1.5 = (1 + .02 + .2) \times 1.5 = 1.83 \text{ required diameter of end of stay.}$$

SPARKS.

The Guelph Light & Power Company have just installed a new dynamo.

M. S. Cornell, of Stanbridge East, Que., will probably install an electric light plant next spring.

The Cardinal, Ont., Electric Light Company has been incorporated, with a capital of \$20,000.

The Deseronto car works have turned out an electric snow plough and freight motor for the Kingston Street Railway Company.

Rev. D. B. Marsh, of Black Heath, Ont., inventor of the Marsh stethophone, is taking out patents in the United States and European countries.

The proposal submitted to the ratepayers of the town of Annapolis, N. S., to raise the sum of \$12,000 to install an electric light plant, was recently voted down.

The works of the Toronto Electrical Works Company, Adelaide street west, Toronto, were recently damaged by fire to the extent of \$10,000, the loss being partially covered by insurance.

The General Electric Company, of Schenectady, N. Y., have just received an order for 32 electric locomotives for the Central London underground railway, at London, England.

The city clerk of Chatham, Ont., is open to receive applications until the 15th instant for the position of city engineer, to take charge of the public works, electric light plant and city water works.

The town council of Napanee, Ont., have accepted a proposition made by John R. Scott to supply electric light. Mr. Scott agrees to install an incandescent and arc light plant within one year.

The Central Electric Light Company, of Portage La Prairie, Man., have elected officers for the ensuing year as follows :— President, Thos. W. Taylor, of Winnipeg ; vice-president, T. B.

Millar ; secretary and manager, M. Blake ; other directors, Judge Ryan, Hon. Robt. Watson, and Wilson Bell. The reports presented showed a prosperous year's business.

The expenses of the municipal electric light plant at Lachine, Que., amounted in 1897 to \$3,282, for a service of 850 incandescent lights and 43 arc lights. The receipts for the same year amounted to \$3,066.

A meeting of the shareholders of the New Glasgow Electric Company, New Glasgow, N. S., was held recently for the purpose of authorizing the company to issue bonds for the sum of \$35,000, with which to wipe out its present indebtedness.

On February 1st fire was discovered in the premises of Ness, McLaren & Bate, manufacturers of telephones and electrical supplies, Montreal. The stock and machinery on the third and fourth floors were almost totally destroyed, the loss being about \$15,000.

The Dechenes Electric Light Company, of Dechenes Mills, Que., are having plans prepared for the construction of dams at Dechenes Rapids, intended to furnish 3,000 horse power. A new power house will also be erected, the contract for which will be let at an early date.

The charge of boodling brought against an alderman of Chatham, Ont., in connection with the installation of an electric light plant, has been dismissed without argument by Judge Houstens. It is said that proceedings will now be taken against the persons instigating the prosecution.

The largest contract for electric lighting ever given in London, Ont., was recently let by Messrs. McGaw & Winnett to the London Electric Company. The contract calls for the lighting of the Tecumseth House throughout, for which purpose between 600 and 700 lights will be required.

A new proposition for the supply of electric power to the city of Toronto has been made by the Georgian Bay Ship Canal and Power Aqueduct Company. The price quoted is six mills per electric horse power per hour, the company agreeing to supply 2,000 horse power within two years from the date of contract.

A live question now before the City Council of Ottawa, Ont., is whether the Deschenes Electric Light Company will be permitted to compete for electric lighting in that city, in opposition to the Ottawa Electric Company. Before deciding the question the aldermen are taking steps to secure as much information on the subject as possible.

Mayor Owens, of New Westminster, B. C., referred in his inaugural address to the rapid growth of the electric light business, and pointed out the necessity of increasing the existing electric light plant, which is owned by the city. Two propositions are submitted, one to increase the present plant, and another to utilize some convenient water power and carry the current to the city by cable. The latter plan is recommended.

By a recent decision of the Supreme Court of Nova Scotia the act by which the Sabbath Observance Society sought to stop the operation of street cars in Halifax on Sunday was declared to be ultra vires of the Provincial Legislature. The Sabbath Observance Society had officers of the Halifax Electric Tramway Company summoned to the Police Court for employing men to perform labor on Sunday. The company asked the Supreme Court for a writ prohibiting the Police Magistrate from going on with the case on the ground that the act was ultra vires.

The city of Winnipeg, Man., recently invited tenders for electric street lighting for a period of years, also for furnishing an electric light plant. In response the following tenders were submitted : Goldie & McCulloch Co., Galt, steam plant, \$10,310 ; Western Electric Company, Chicago, \$20,850, \$21,950 and \$21,800 ; Robb Engineering Company, Amherst, N. S., \$19,330, \$20,480 and \$21,200 ; McDonald Bros., Winnipeg, poles, wiring, etc., \$22,500, steam plant, \$9,068 ; Manitoba Electric Light and Gas Company, Winnipeg, from 47c. to 45c. per light per night for 121 lights for one year, for a period of from two to five years and for 200 lights, 39c. per light per night ; Northwest Electric Light Company, Winnipeg, 121 to 200 lights, 40c. per light per night ; W. A. Johnson Electric Company, Toronto, 200 lights, \$19,265, including everything for supplying 250 lights \$33,366 ; Fort Wayne Electric Corporation, Fort Wayne, Ind., electric plant, \$9,285 ; Royal Electric Company, Montreal, electric plant, \$10,000 ; installing and brickwork in, \$9,500 extra (this company submitted a supplemental tender of \$12,050) ; Canadian General Electric Company, Toronto, electric plant, \$13,540. No award has as yet been made, and it is probable that an electrical expert will be engaged to report on the tenders submitted.

ELECTRIC RAILWAY DEPARTMENT.

ANNUAL MEETING OF TORONTO STREET RAILWAY COMPANY.

THE annual meeting of the Toronto Railway Company was held on January 19th last. The report presented stated that the net profits of the year 1897 were \$332,022. From the profits two dividends, at the rate of $1\frac{3}{4}$ per cent. each, had been declared, amounting to \$210,000, leaving, after the deduction of pavement charges, the sum of \$62,022.50 to be carried forward. The gross earnings for the year showed a most satisfactory increase over the corresponding period of 1896. Apart from the increase due to the operation of the company's system on Sundays since 23rd May, receipts show steadily augmenting increases, and the directors have every reason to trust that same will continue throughout the present year. The average earnings on Sunday since that date were \$1,277, which, on the whole was considered satisfactory, having in view the limited nature of the service.

The policy of keeping the plant in a high state of efficiency was maintained. The increased business having called for additional rolling stock, ten closed and twenty open motor cars were built in the company's shops, 31 iron trucks and 50 standard electric motors were added to the equipment, and in anticipation of further increased business the company have under consideration the building of additional cars for the current year. The appointment of Mr. E. H. Keating as manager of the company, to succeed Mr. Wanklyn, was sanctioned. The financial statement showed gross earnings of \$1,077,612 and operating expenses of \$525,801, leaving the net earnings for 1897 \$551,811. There were carried 25,271,314 passengers, and 8,169,022 transfers were granted. The total assets of the company are valued at \$9,957,159.

The board of directors was elected as follows: William Mackenzie, James Ross, F. L. Wanklyn, W. D. Matthews, James Gunn, C. E. L. Porteous, G. A. Cox. At a subsequent meeting of the directors Wm. Mackenzie was elected president and James Ross vice-president.

THE QUEBEC DISTRICT RAILWAY.

DURING the year 1897 the citizens of Quebec and vicinity were afforded the means of quick transportation, the Quebec District Railway Company having put into operation some twenty miles of electric road. The old horse car system was taken over and electrified, and other extensions made wherever the traffic would seem to warrant. The power for operating the road is supplied by the Montmorency Electric Power Company, from their magnificent station at Montmorency Falls, a description of which has already appeared in the ELECTRICAL NEWS.

The whole equipment of the road, with the exception of the rails, was furnished by Messrs. Ahearn & Soper, of Ottawa. The rolling stock consists of 30 vestibule cars, upholstered in best Wilton, cherry finish, mounted on Taylor trucks, each car equipped with two 12-A 30 h. p. Westinghouse motors, with multiple series controllers. Each car is lighted with fourteen lamps, and heated by Ahearn & Soper electric heaters, which are placed beneath the seats and are invisible. The cars are exact duplicates of those in use on the Ottawa system, including the same method of collecting fares

and registering. There are five electric snow sweepers, each sweeper equipped with three 12-A 30 h. p. Westinghouse motors.

The overhead construction includes iron poles throughout. The trolley wire is No. 00 and the feeders are 500,000 circular mils. The rails are of the T pattern, 72 lbs. per yard in weight, and the whole track construction is of most substantial character.

Owing to the narrow streets in Quebec a great deal of the road is single track, thus necessitating a large amount of bracket work. The brackets were specially designed by Ahearn & Soper, and are of the most practical and substantial character. It is stated that the Quebec road is operated at 30 per cent. of its gross receipts.

The manager and chief engineer, under whose direct supervision the road has been constructed, and to whom the success of its operation is due, is Edward A. Evans, C. E. The officers of the company are as follows: President, Andrew Thomson; vice-president, E. W. Methot; secretary treasurer, J. R. H. White.

The steepest grade at present in use at Quebec is on Crown street, and is $15\frac{1}{4}$ per cent. Heavily loaded cars ascend this grade without difficulty.

BRITISH COLUMBIA ELECTRIC RAILWAY COMPANY.

THE British Columbia Electric Railway Company, which is composed of British capitalists, issued a circular to the shareholders recently, in which the secretary says:

My directors desire me to convey to you the working results of this company for the first half-year of its existence. The directors particularly wish to draw your attention to the fact that the period under review is two weeks less than the full six months, the properties having been taken over on April 15th, and the books made up to September 30th. For that period the results were as follows:

	Gross Earnings.	Working Expenses.	Net Profits in British Columbia.
April (15 days).....	\$10,992.55	\$ 7,900.58	\$3,091.97
May.....	21,604.54	15,741.31	5,863.23
June.....	23,305.24	16,443.28	6,861.96
July.....	23,435.74	16,361.44	7,074.30
August.....	26,739.61	17,730.20	9,009.41
September.....	24,665.91	17,336.17	7,329.74
	\$130,743.59	\$91,512.98	\$39,230.61 = £8,072

Deducting expenditures in London, Eng., the surplus for the complete six months is given as £2,300.

This satisfactory result is due to steady improvement in business, fairly evenly distributed amongst all the branches, and little benefit, if any, has as yet been derived from the various improvements which are at present being carried out with the capital derived from the issue of the income bonds. Of the improvements, to carry out which the issue of income bonds was made, the extension to Stanley Park, and the improvements on the Westminster branch have been satisfactorily completed, and the economy of £3,500 per annum expected from them should shortly commence to show in the returns. The installation of water-power at Victoria is in course of construction, and, the board anticipate, will be finished about March 31st. Before finally making this important expenditure of capital, the board decided to call in still further expert advice, and secured the services of Mr. J. M. Campbell, of Toronto, electrical engineer of very high standing, and of long experience in this class of business. The board is glad to state that Mr. Campbell not only confirmed the opinion of the previous expert, but put the increased annual profits to be derived by substitution of water power for steam power, and the other improvements in Victoria now in hand, at £9,000 per annum. The installation of water power at Vancouver has been deferred for the present.

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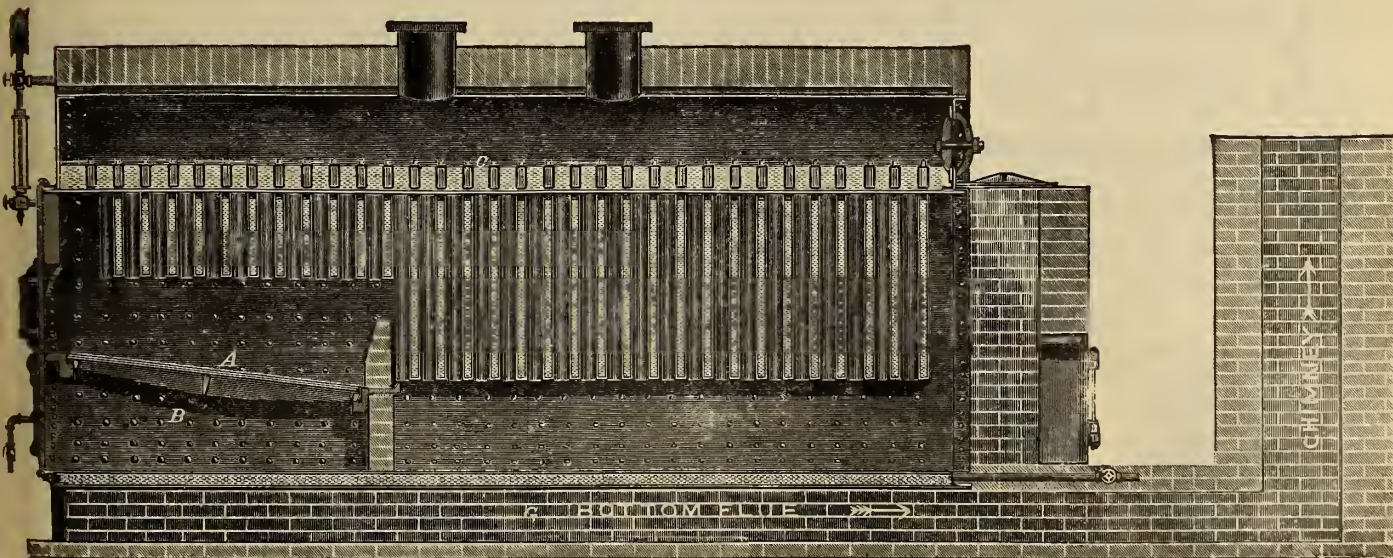
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SPARKS.

The S. Hadley Lumber Company, of Chatham, Ont., are supplying the ties and poles for the electric street railway at St. Thomas, Ont.

Mr. A. J. Corriveau, the promoter of the Montreal and South Shore railway, states that the work of construction will be pushed ahead early in the spring.

The experiment of laying a telegraph cable from Port Angeles to Victoria, B. C., is deemed impracticable, owing to the tremendous strain that would be exerted on the line by the heavy tides and extremely rough water.

For injuries received in a street accident, Mrs. Gage and Mr. John T. Gage, of Hamilton, were awarded damages of \$900 and \$300 respectively. Their suit against the Hamilton Street Railway Company was for \$5,000.

The car barns of the Metropolitan street railway, North Toronto, were destroyed by fire on the 23rd ultimo. All the rolling stock of the company excepting one car was burned. The loss is about \$10,000, fully covered by insurance.

Last year the Galt, Preston & Hespeler Electric Railway carried 221,674 passengers, an increase of 2,027 over the previous year. The total freight carried was 12,973 tons, an increase of 4,663 tons. The increased earnings were \$1,900. President Todd has been re-elected.

The Hamilton & Barton Incline Railway Company held its annual meeting a fortnight ago, at which a dividend of three per cent. was declared. Directors were elected as follows: George E. Tuckett, president; John Dickenson, vice-president; L. Bauer, secretary; W. Hendrie and John Clark, directors.

The Hamilton Street Railway Company, at its annual meeting last month, re-elected the board of directors as follows: Messrs. Wm. Gibson, M.P., president; Edward Martin, Q.C., vice-president; F. W. Fearman, W. J. Harris, B. E. Charlton, I. Beer, John A. Bruce. Mr. J. H. Griffith was re-appointed manager. No dividend was declared.

Ahearn & Soper, of Ottawa, have built for the Hamilton, Grimsby & Beamsville railway a new palace car, which is claimed to be one of the finest in Canada. It is built in full Pullman style, and capable of seating 60 passengers. The interior is finished in black oak, with monograms on every window, electric bells for the passengers, and adjustable card tables for use when desired. The cost was about \$4,500.

The York County Council are taking steps to secure legislation from the Ontario government placing the control of street railways in the county under the jurisdiction of the county council, with the rights of appeal by any local municipality to the Lieutenant-Governor-in-Council. This would enable the county

to build railways along the various highways notwithstanding objections on the part of any municipality.

The annual meeting of the Hamilton, Grimsby and Beamsville Railway Company was held at Hamilton on January 24th. It is said that the meeting was by no means harmonious. The management claim an increase in receipts over the previous year of 21 per cent., this being partly accounted for by the Beamsville extension and the connection with the C. P. R. for fruit carrying purposes. The former directors were re-elected.

At the recent annual general meeting of the Ottawa Electric Railway Company, the annual report showed that 4,762,082 passengers were carried during the year, and 1,538,836 miles covered, and that four quarterly dividends of two per cent. were paid. A satisfactory increase in receipts was reported, especially since the month of September. The following were re-elected directors: Messrs. J. W. McRae, T. Ahearn, G. P. Brophy, Warren Y. Soper, Thos. Workman, Peter Whelan and William Scott. Mr. J. W. McRae was re-elected president, and Mr. T. Ahearn vice-president and managing director.

According to the statement presented at the recent meeting of the London Street Railway Company, there were carried during 1897 a total of 2,558,000 passengers, and nearly one million car miles were traversed. The gross earnings were \$101,365, and the operating expenses 56.7 per cent of the earnings. There was an increase of 158,000 in the number of passengers carried. The officers were re-elected as follows: President, H. A. Everett, Cleveland; vice-president, C. W. Moore, Cleveland; directors, Messrs. Everett, Moore, C. W. Wason (Cleveland), Holt (Montreal), T. H. Smallman (London); secretary-treasurer and general manager, C. E. A. Carr.

During the year 1897 the Bout d'Ile Electric Railway Company carried out considerable construction work in the vicinity of Montreal. The system was connected with the Canadian Pacific railway freight yards on Moreau street. This new branch, which brings the Chateauguay and Northern into immediate connection with the C. P. R., embraces about 1½ miles of track, the rails being 60 lbs. to the yard, so that goods can now be billed from any part of the C. P. R. to any point on the electric road in question. There are two fine sidings on the new extension and the equipments appear to be all first-class. The poles are 35 feet high and 100 feet apart, while overhead the bracket system has been used. The trolley wire is 21½ feet from the rail, so as to permit a standard railway traffic, as it is expected that a great quantity of freight will be interchanged from one road to the other. Overhead of this are three wires, one a large feeding wire, which extends all the way from Charlemagne Ferry to the Canadian Pacific, while the other two are the metallic telephone circuit.

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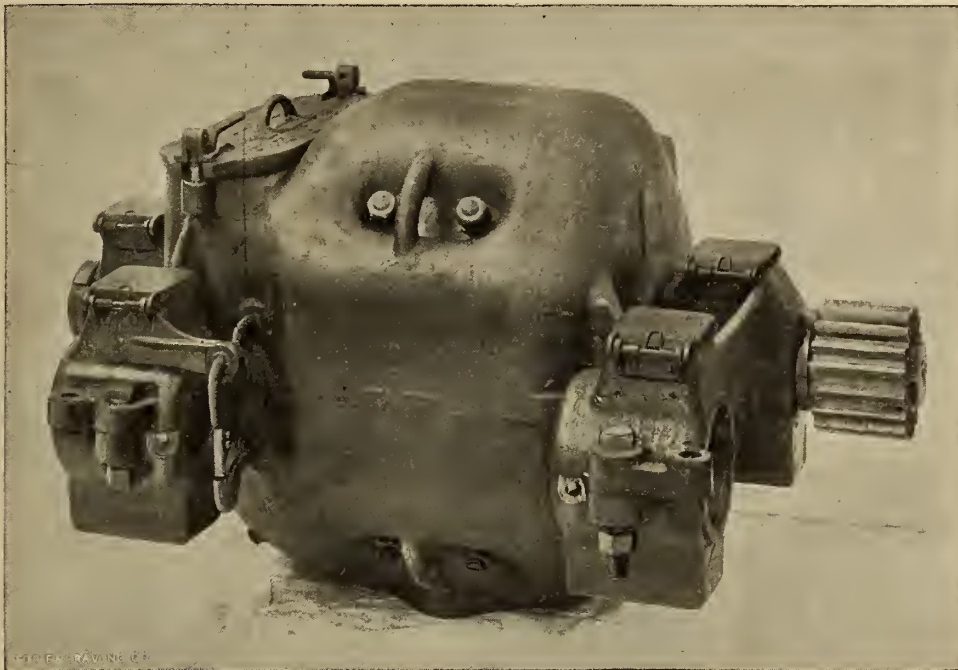
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TRADE NOTES.

The contract for all the work in connection with the lighting of the Parliament Buildings at Ottawa has been placed with Ahearn & Soper, of that city.

The Globe File Mfg. Co., of Port Hope, Ont., have recently added to their extensive plant what is known as the steel rope drive system for operating their machinery, in place of the old cog-wheel system. The work was carried out by the Dodge Wood Split Pulley Co., of Toronto.

Messrs. Ness, McLaren & Bate, manufacturers of telephones and electrical apparatus, Montreal, whose premises were recently seriously damaged by fire, are now located in temporary quarters at 761 Craig street, where they are in a position to fill all orders with the same promptness as in the past. After rebuilding, they expect to locate at their former address, 749 Craig street.

A very complete electric light plant has lately been installed by John Starr, Son & Co. in the factory of the Truro Condensed Milk Company, which is giving perfect satisfaction. This consists of a dynamo of capacity of 150 lights, which also furnishes current for heating the soldering irons in the can factory. The same firm have also connected the different departments with their "Unique" warehouse telephones.

The General Engineering Company of Ontario is in process of formation in Toronto, to purchase the assets of the Weeks-Eldred Co., of Toronto, Limited. The objects of the new company are to buy, sell, manufacture and deal in mechanical stokers and other steam, electrical, heating and ventilating appliances and general machinery, and to carry on a general contracting business. Mr. James Milne, manager of the Weeks-Eldred Company, is chief promoter of the new enterprise.

The Dodge Wood Split Pulley Company, of Toronto, have issued a most complete catalogue of their patent wood split pulleys and power transmission appliances. It contains nearly 300 pages, in which are to be found many valuable tables and numerous illustrations. The preface says: "Our aims and

efforts are constantly directed towards the perfecting of power transmitting machinery and the advancement of the practice governing the usages of this very important branch of mechanics. The present age is one of progress and economy; it therefore behooves every owner, or prospective owner, of a power plant to familiarize himself with the best practice in transmission engineering. Money saved at the coal pile means larger dividends for the stockholders."

To the Royal Electric Co., of Montreal, belongs the credit of having produced one of the most useful and best designed calendars which has yet come before our notice. It is a blotting pad, of convenient size for an office desk. In the upper right hand corner is a neat calendar, and directly below a pocket in which an engagement book is designed to slide, leaving visible only the word engagements. This book is dated for the entire year, and on the left hand pages appear Frund's and the National moonlight schedules, together with valuable wiring tables, price lists, and other information. The announcements of the well known "S.K.C." generators, motors, transformers, etc., are made in gilt letters, which appear to good advantage on the dark brown background.

The T. & H. Electric Co., successors to the Kay Electrical Mfg. Co., report the following recent sales: Messrs. Hallman & Co., Berlin, 12 h.p. motor; Toronto Cold Storage Co., 5 light dynamo; Journal Printing Co., St. Catharines, 5 h.p. motor; Geo. Membrey, St. Catharines, 3 h.p. motor; Toronto Ornamental Iron Co., 1000 gal. plater; Messrs. Meakins & Co., 1 h.p. motor; R. N. Grundy, Guelph, 200 gal. plater; Berlin Felt Boot Co., 150 light dynamo; A. R. Woodyatt & Co., Guelph, 250 gal. plater; J. C. Harris, Toronto, one 15 h.p. and one 10 h.p. motor; McKinnon Building, Toronto, one 15 h.p. and one 10 h.p. direct connected motors and controllers; Garrioch & Goddard, Ottawa, one 2 h.p. and one 4 h.p. motor; Berlin Shirt & Collar Co., 4 h.p. motor; D. W. Karn & Co., Woodstock, Ont., automatic organ blowing machine, besides several machines in Victoria, B. C., and Woodstock, N.B.

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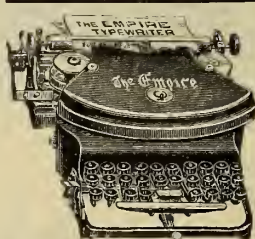
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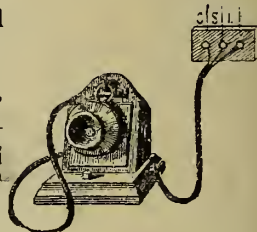
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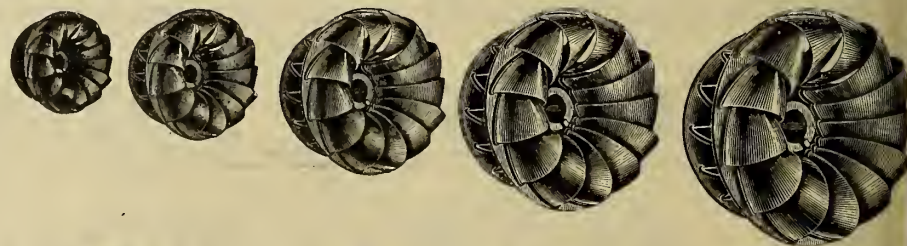
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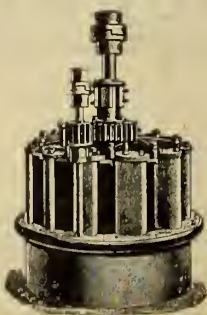
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GO OVER EACH ITEM CAREFULLY

POINTS OBSERVED.	COMPETITIVE.		ORDINARY.	
	Jones'.	Hand.	Jones'.	Hand.
Duration of test in hours	94.2	93.75	18.	18.
Total coal burned, including wood equiv., in lbs.	74447.	81770.	13600.	15000.
Water evap. from temp. of feed, in lbs.	621080.	593945.	126113.	112338.
Average steam pressure.....	159.7	158.5	158.	158.
Total ash	6158.	8998.	Not weighed.	
Actual evap. per lb. coal from temp. of feed in lbs.....	8.3426	7.262	9.227	7.489
" " " comb. " " " " " "	9.081	8.161	....	....
Equiv. " " coal from and at 212°, in lbs.	9.332	8.121	10.3342	8.3876
" " " comb. " " " " " "	10.147	9.127	....	....
Percentage ash.....	8.2	11.	....	....
Relative economy.....	114.78	100.	123.2	100.

QUESTION—If the above results are obtained with Excellent Hand Firing, what would the results be with Indifferent and Poor Firing? Think on this and then ask yourself if you can afford to be without the Stoker. It is the **ORDINARY WORKING** Test that tells the tale, not the **COMPETITIVE**.

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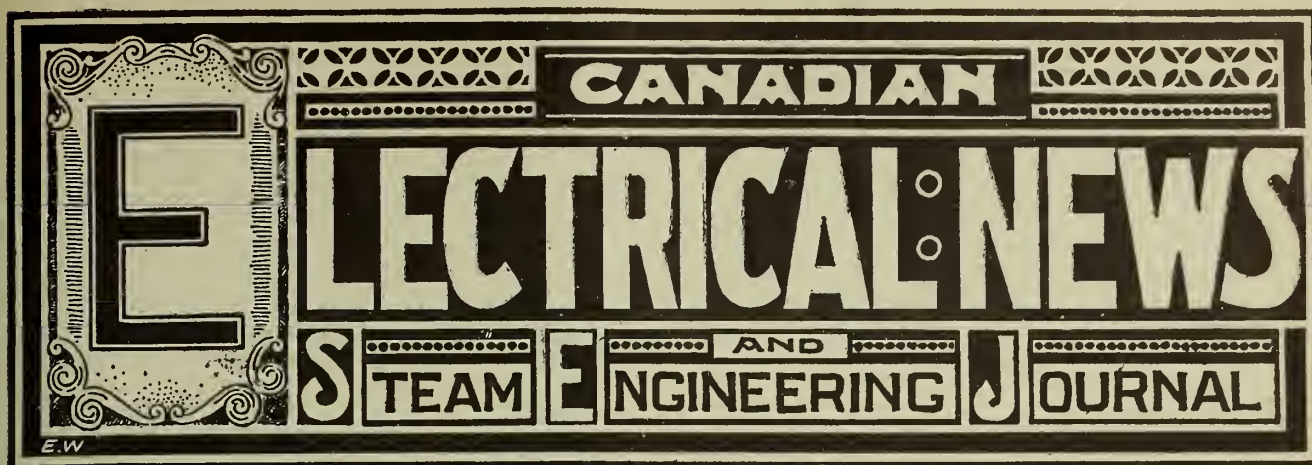
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Description of the Toronto Electric Light Company's New Fire-Proof Station (Illustrated).
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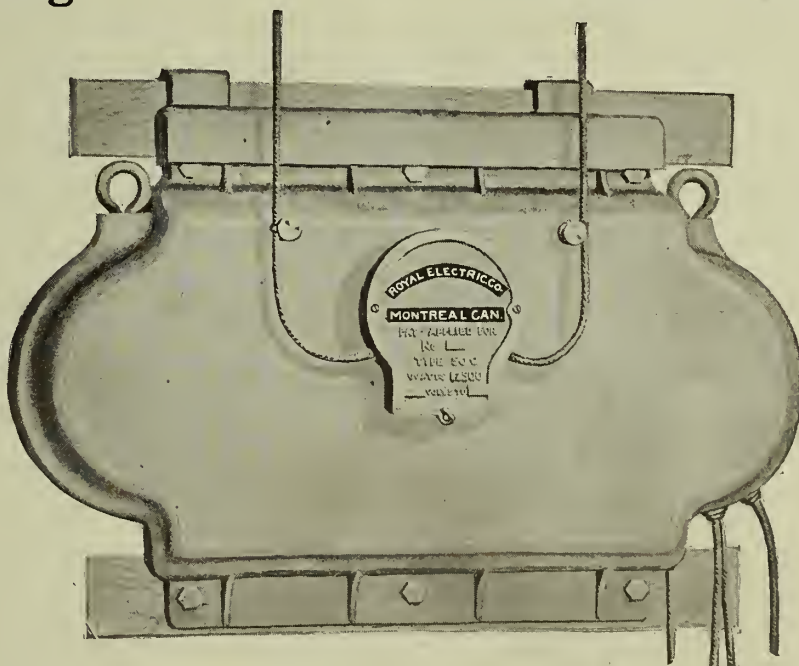
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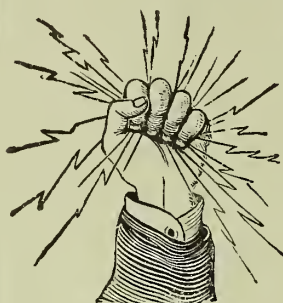
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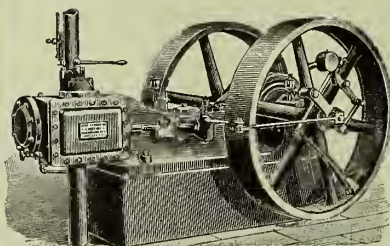
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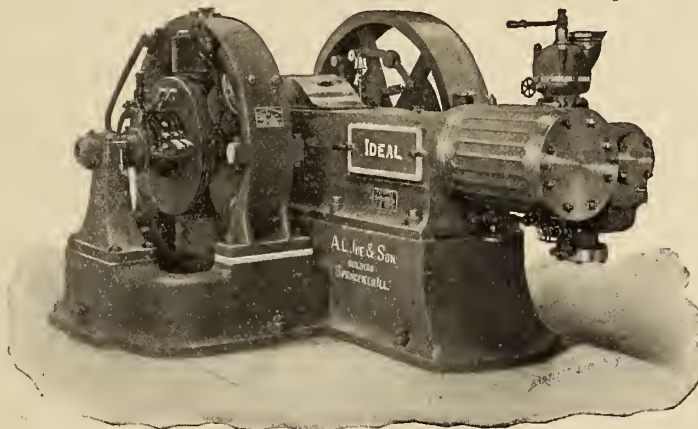
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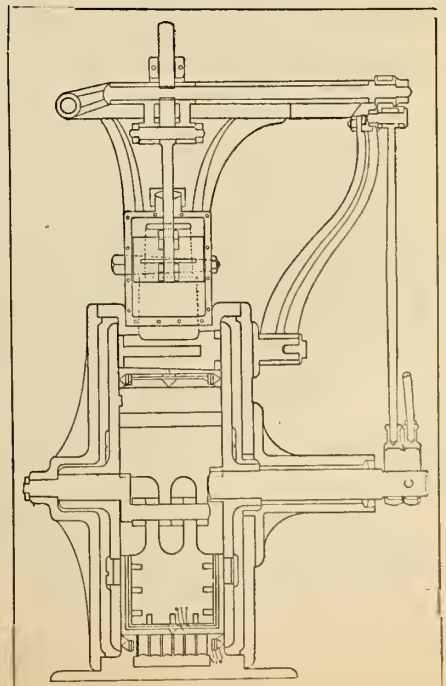
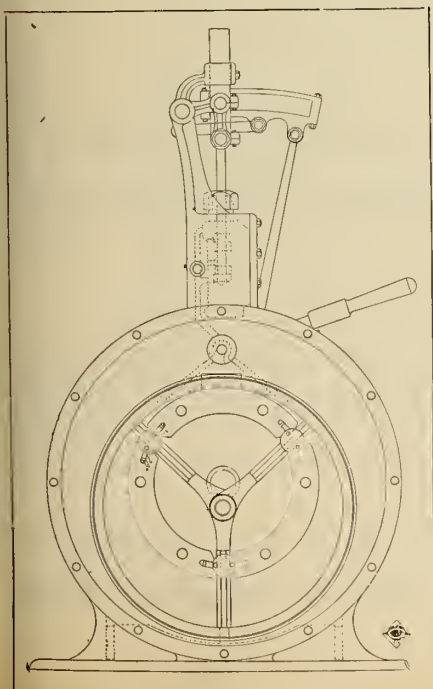
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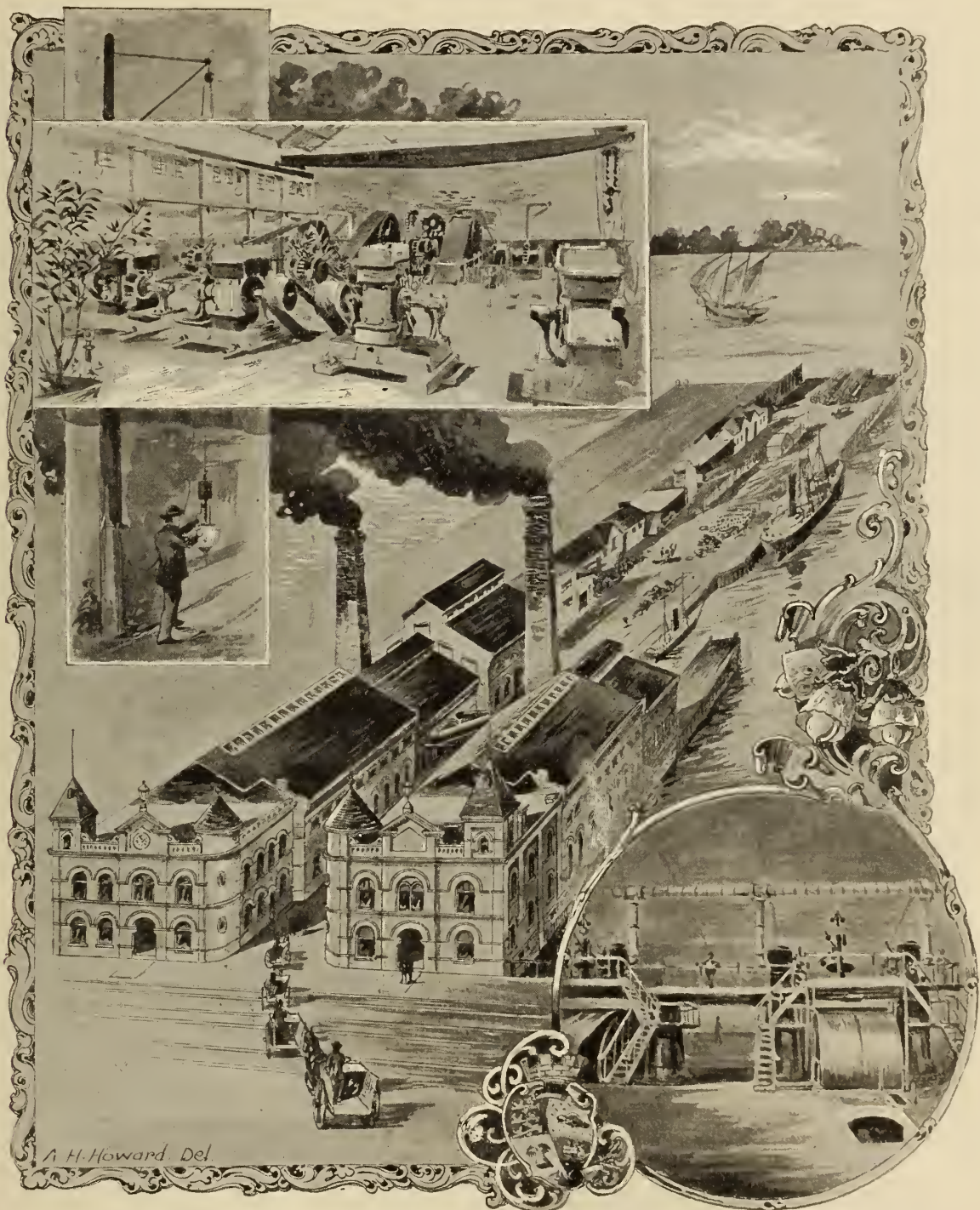
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CANADIAN
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STEAM ENGINEERING JOURNAL.

Vol. VIII.

MARCH, 1898

No. 3.



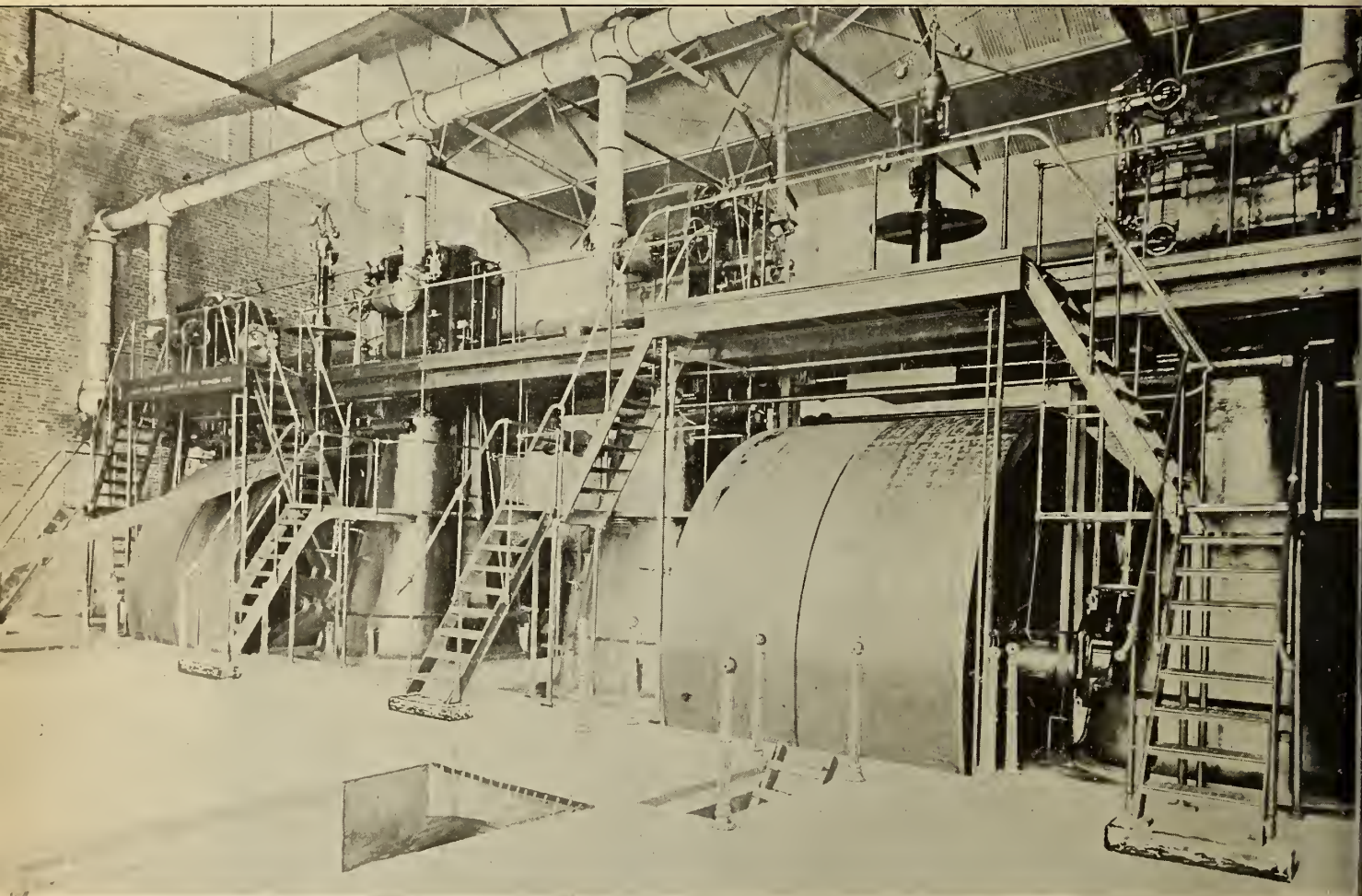
THE SCOTT STREET POWER HOUSE AND DOCK OF THE TORONTO ELECTRIC LIGHT COMPANY, LIMITED.
(For Illustrated Description see following pages.)

THE NEW WORKS OF THE TORONTO ELECTRIC LIGHT COMPANY.

On the 21st day of January, 1897, the arc light station of the Toronto Electric Light Company was totally destroyed by fire. The building was of frame covered by corrugated iron, and had served the needs of the company in the early stages of its career. The continual increase in the number of dynamos and engines had necessitated the building of platforms to carry the dynamos above the shafting, and finally the building became very much crowded. Although there was considerable timber in the structure it was thought that owing to the continuous presence of the employees the risk was not great. Events proved differently, however. So sudden was the outbreak that all the engines could not be stopped, and the men had to make a hurried exit by the windows, leaving even their personal effects behind. Owing to rapid temporary work the lighting of the city was very little interfered with, and work was at once commenced to clear the ground for a new structure.

circuit desired, and also polarity indicators to ensure the currents flowing in the proper direction.

When the ground was cleared the first thing done was to drive piles for the foundations to the solid rock. Such piles as were under the old building were utilized, and new ones driven where necessary. The piles were cut off level at the lowest water line, and on them was laid a solid bed of concrete over the entire space, 2 feet 9 inches in thickness. Upon this the dynamo foundations were built, and were carried up to a height sufficient for headroom under the arches which connected them together. This formed tunnels for the shafting, the pedestals for which were anchored to the concrete bed. Intermediate arches, wherever necessary to continue the floor between dynamo foundations, are carried on heavy I beams on cast iron pillars. Stairs to these tunnels, doors, window frames, roof beams, railings, etc., are all of iron. There is also a twenty ton travelling crane which can be used over any part of the floor. This has been of great advantage in handling the machinery dur-



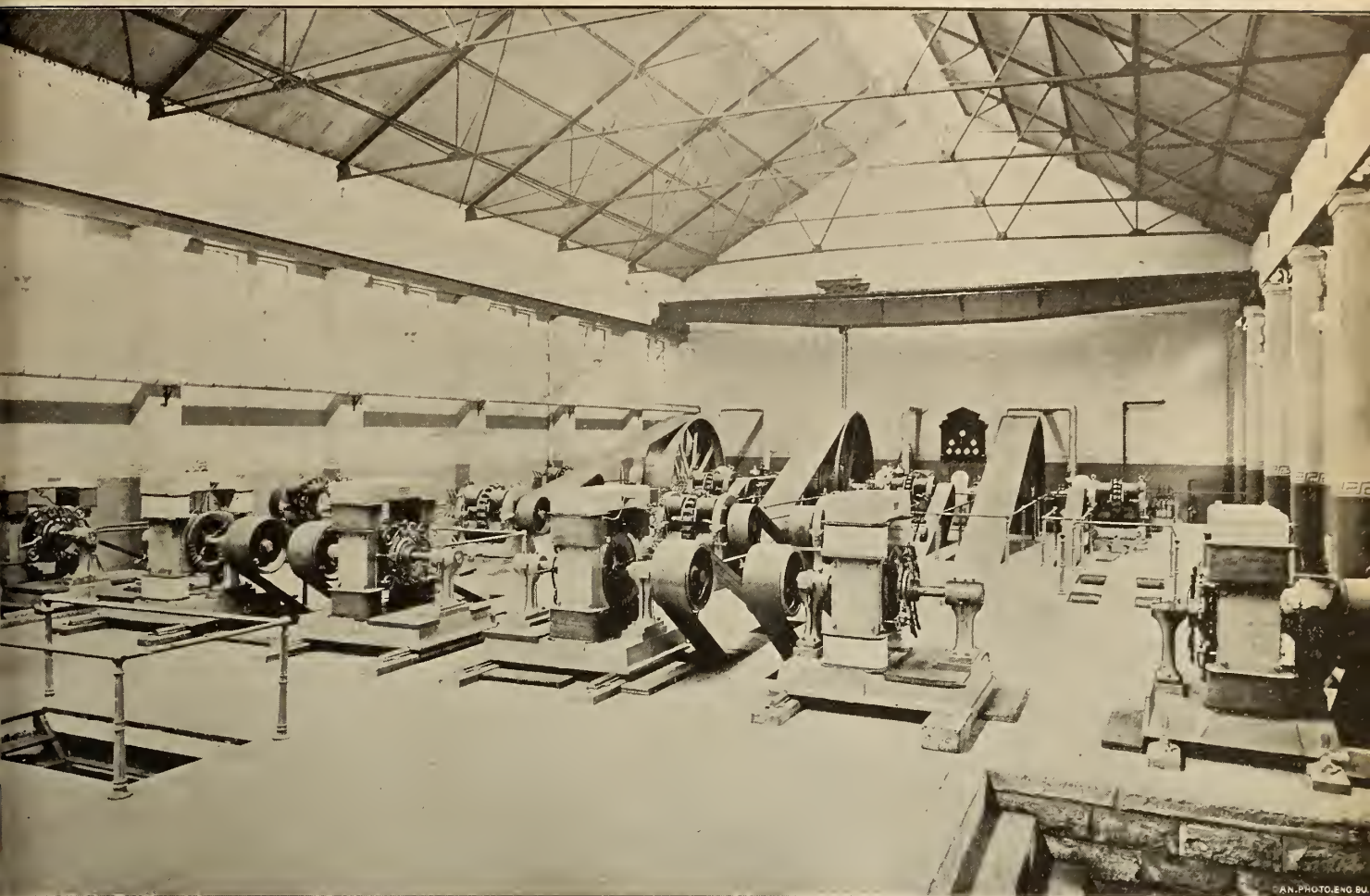
3,000 H.P. ENGINES IN NO. 3 STATION, TORONTO ELECTRIC LIGHT CO.

Steam derricks were erected, and the dismantled dynamos, shafting and engines lifted out and cleared away. While the ground was being cleared plans were got out for new structures, and it was determined that, whatever might be the next cause of trouble, it would not be fire. There is absolutely no wood or any combustible substance used in any part of the construction. We are enabled to present our readers with a general view of the reconstructed works and some of the details of the various buildings. The arc light station No. 1 is shown by photographs taken of each end from the center of the building. At one end will be seen the arc light switchboard, which is built of pressed brick with terracotta trimmings, and is surmounted by a clock driven by electricity, which is one of a number distributed around the works, and forming part of the general time system that is being introduced into various parts of the city. Each arc circuit has ampere meters on the face of the switchboard large enough to be seen from any part of the room, and behind the wall there is a slate shelf for standard ammeter, which can be plugged into any

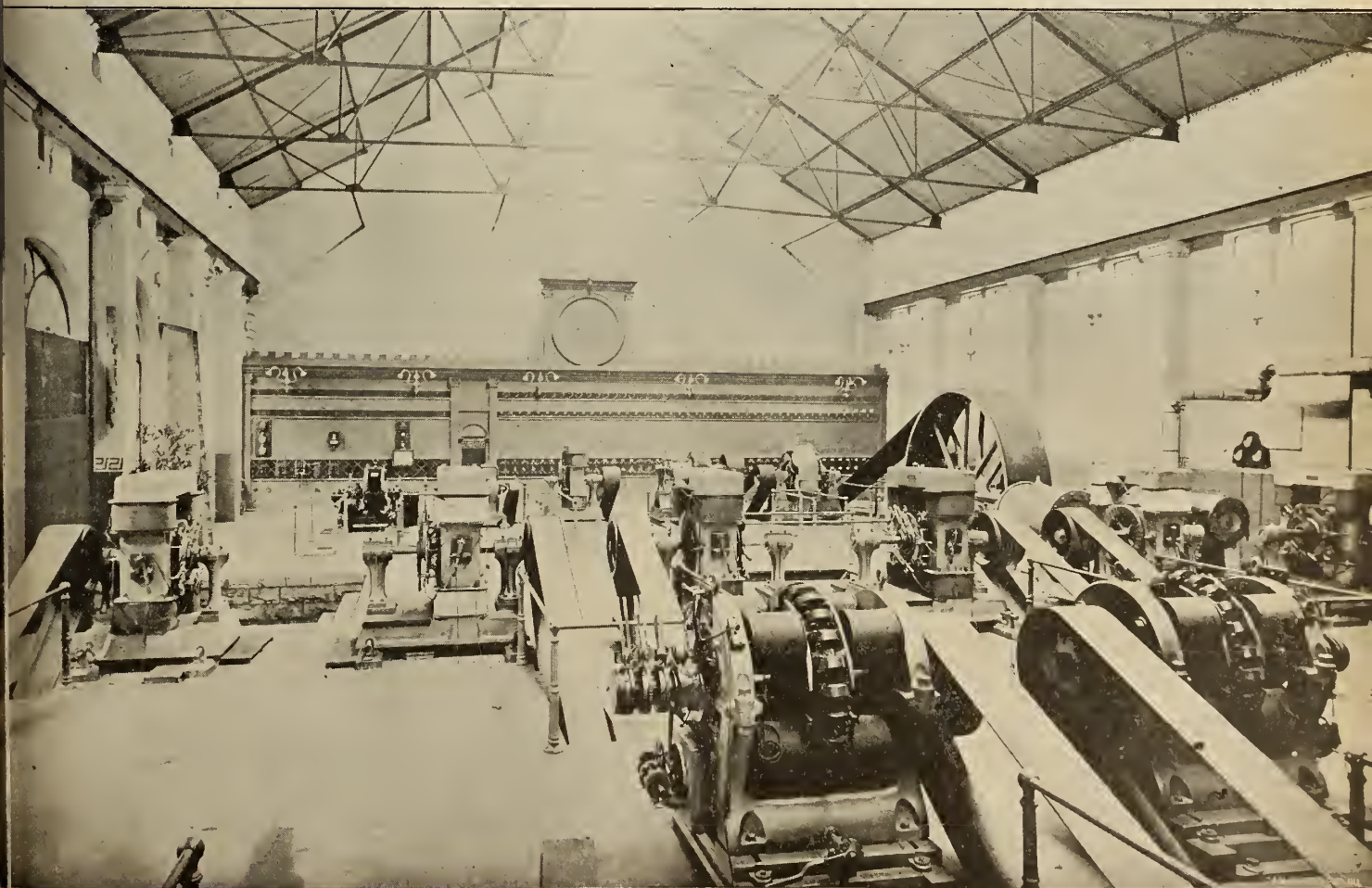
ing installation, and will no doubt effect a considerable saving in time in the event of the machinery being handled for repairs. The shafting is all extremely heavy and runs in self-oiling bearings of the best design. There appears to be nothing omitted that experience has shown to be advantageous in the operation of an electric light installation.

The building in front and to the east of the general offices of the company is now being finished, and will be utilized as store rooms for all supplies, show rooms for incandescent fixtures, and meter department. This building is erected entirely of brick and iron, with concrete floors and terra cotta partitions. It also contains accommodation for nightwatchman and for linemen on duty at night, with horse and quick hitching attachment for sudden calls. This saves time that would be necessary to get a horse and rig from the general stables, which are situated at the rear end of the lot.

Station No. 3 is also a brick and iron building of a similar character to the arc light station, and is equipped with two pairs of upright Corliss engines of 1000 to



ENGINE END OF NO. 1 ARC LIGHT STATION, TORONTO ELECTRIC LIGHT CO.



SWITCHBOARD END OF NO. 1 ARC LIGHTING STATION, TORONTO ELECTRIC LIGHT CO.

1500 h. p. each. These engines are shown in our illustrations. There are four dynamos in this building—two of 500 k.w. capacity 250 volts for motive power purposes, and two alternators of 450 k.w. capacity each. One of the illustrations shows a direct current generator, but owing to the limited space available for the purposes of the photographer, it does not give a very clear idea of the surroundings. In this cut may be seen one of the automatic cut-off air pumps and condensers, which are used throughout the installation.

Station No. 2, or the most westerly of the lot, is a similar construction to the building that was destroyed, with the exception that it is lined inside as well as out with sheet iron, and the floor joists and uprights are also cased in sheet iron. It contains a double tandem upright Corliss engine of 1000 horse power capacity, and also the general distributing switchboard for all the output of current for power and incandescent light purposes. It is the intention to rebuild this as soon as the weather permits, and replace the present structure with

The detail of the foundation work, some of which was of a very difficult character, having to be laid under water, as well as the general arrangement of the buildings, are of a very interesting character and would well repay a visit by anyone interested in such matters. Visitors are always welcome and will be shown anything and everything in connection with the operation of this extensive plant.

A LETTER OF THANKS.

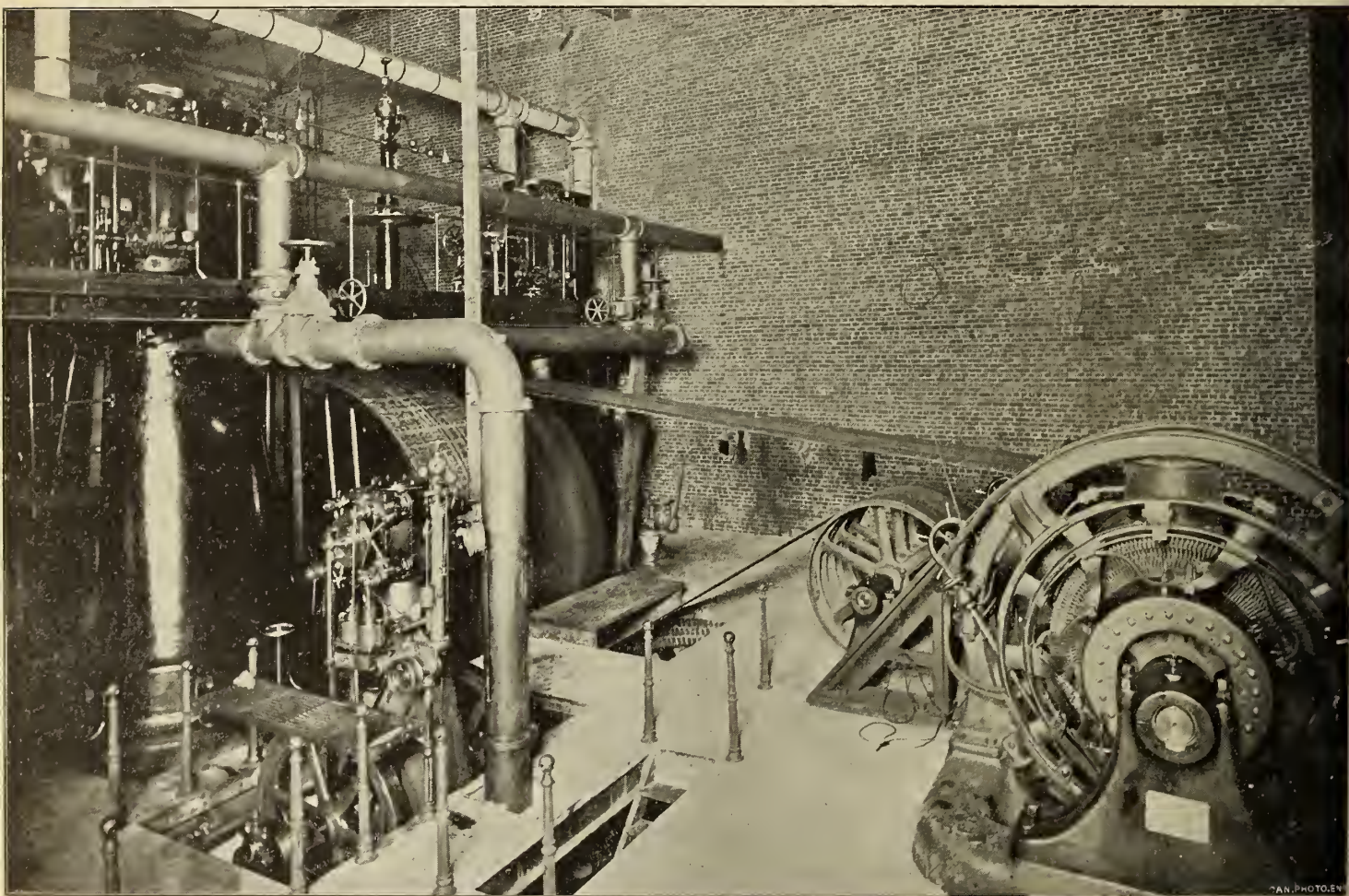
MONTREAL WEST, February 9th, 1898.

To the Editor of the CANADIAN ELECTRICAL NEWS.

SIR,—Permit me to thank those of your readers who so kindly forwarded samples of boiler scale and feed water in connection with articles now in course of publication in the ELECTRICAL NEWS.

Personally the results have been indeed gratifying. With the exception of P. E. Island, I have received samples from every province in the Dominion; and what is more pleasing, samples have been received from steam users, engineers, and manufacturers of scale resolvents, as well as dealers in this line of goods.

This is also a gratifying evidence that the ELECTRICAL NEWS



DIRECT CURRENT GENERATOR, 250 VOLTS, 500 K.W., TORONTO ELECTRIC LIGHT CO.

a building of a similar class to the new ones. The foundations have already been built of stone and concrete, and it is expected that the building will be completed in the early summer. The engine will have a new fly wheel of 60 inches face, and the shafting will be rearranged and placed in brick tunnels, as in the new buildings, and the space that will be gained will be arranged for the installation of two direct connected units of 1000 h.p. each.

The company have also decided to erect coal handling and storing machinery of the latest type, so that coal arriving by vessel can be unloaded and delivered in the boiler houses with the minimum of handling and expense.

The whole of the works above specified, including the rebuilding of one of the boiler houses, and the construction of the iron roof, have been done by the employees of the Toronto Electric Light Company, including the original designs and all the labor necessary in the carrying out of the various works—the only exception being the pile driving and the construction of the travelling crane, which were done by contract.

is widely read, and that the subject is an interesting one to all classes of readers.

Unfortunately articles of this kind cannot be written in popular style. I shall in future, however, endeavor as much as possible to avoid the use of technical terms.

I cannot too highly express my thanks to those engineers with whom I entered into private correspondence for their very flattering appreciation of the work upon which I have been engaged.

Yours very truly,

WM. THOMPSON.

The United States Consul Morris, of Ghent, Belgium, states that the most extensive product of the world is charcoal thread, which is employed for incandescent lamps, the article for the most part being manufactured at Paris, and coming from the hands of an artisan who, for the present remains unknown in order to better protect the secret of manufacture. It is by the gramme— $15\frac{1}{2}$ grains—that this product is sold at wholesale, and, in reducing its price to the basis of pounds, it is found that the filament for lamps of twenty candles is worth \$8,000 per pound, and that for lamps of thirty candles is rated at \$12,000 per pound; the former have a diameter of 0.020 of a millimetre—one millimetre equals 0.0394 inch—and the latter of 0.0045 of a millimetre.

CORROSIVE AND SCALE-FORMING AGENTS IN BOILER FEED WATERS.

By. WM. THOMPSON.

[ARTICLE 3].

HAVING discussed the presence of corrosive agents in solution, we now require to turn our attention to the presence of impurities likely to occur as dissolved solids and solids held in mechanical suspension, some of which are liable to form scale or encrustation.

The total solids contained within a boiler feed water may be in either of one of two conditions, in mechanical suspension, as small particles, or in chemical solution; and water may contain impurities as per following table:

In mechanical suspension:

Organic matter	{ Animal.
	{ Vegetable.
Inorganic matter	{ As sand,
	{ mud, etc.

In solution:	Organic matter	{ Animal.
		{ Vegetable.
Inorganic matter		{ Scale forming.
		{ Non scale forming.

Matter in mechanical suspension, whether organic or inorganic, may be removed by filtration, but matter in chemical solution, as dissolved impurities, cannot be removed by mere filtration, but must receive treatment either by chemicals or heat, the aim being to get a precipitation whereby we have the impurities in condition first named.

I shall not attempt to deal with the whole of the chemical compounds that may at times be found in natural waters, but confine myself to those compounds of common occurrence with which we are all well acquainted. These may be classed as the oxides, chlorides, carbonates, bi-carbonates and sulphates, being the compounds formed by the union of the various acid radicles with the basic radicles or metallic elements, those most commonly found being silicon, aluminum, iron, calcium, magnesium, sodium and potassium.

Before proceeding to discuss the nature of the scale formed or the action of these various compounds within the boiler, it is first necessary to briefly explain their presence in the water. One of the commonest and most important of these groups of salts, and a group with which we are most frequently called upon to deal, is the carbonates. They are very widely distributed, being found in considerable quantities nearly the world over. Carbonate of calcium is found in the well known forms of limestone, marble, chalk, coral deposits, etc. Carbonate of magnesium occurs quite frequently as magnesite and in combination with carbonate of calcium very largely as dolomite.

Carbonate of iron occurs less frequently, and not so largely diffused in nature, as siderite or spathic iron.

The carbonates of the alkaline bases, sodium and potassium, occur very largely in the alkaline districts, but being soluble at all temperatures found in boiler practice, do not play such an important part in engineering practice as scale-forming agents as do the carbonates of the alkaline earths.

The whole of the carbonates are formed by the union of carbonic dioxide (CO_2) with some one of the metallic oxides, such as calcium oxide (CaO), magnesium oxide (MgO), sodium oxide (Na_2O), etc.

The usual chemical reaction taking place may be classed as a double one, carbonic dioxide (CO_2) first combining with water (H_2O) to form carbonic acid (H_2CO_3). The metallic oxides just named enter into combination with carbonic acid as follows:

Calcium Oxid.	Carbonic Acid.	Calcium Carbonate.	Water.
CaO	$+$	H_2CO_3	$=$
		CaCO_3	$+$
		H_2O	

Magnesium Oxid.	Carbonic Acid.	Carbonate.	Water.
MgO	$+$	H_2CO_3	$=$
		MgCO_3	$+$
		H_2O	

In this case the bi-valent basic radicles of calcium and magnesium replace the hydrogen of the carbonic acid and the liberated hydrogen enters into combination with the oxygen of the metallic oxide; consequently from the combination of two chemical compounds as shewn in equation two new compounds, consisting of either of carbonates of calcium or magnesium and water, are formed. The combination between the oxide of sodium and carbonic acid is practically the same with this exception: Sodium is a univalent metal, consequently has the power to replace only one atom of hydrogen, therefore one molecule of sodium oxide must always consist of two atoms of the metal sodium in combination with one atom of oxygen. The chemical reaction for the production of sodium carbonate therefore is:

Sodium Oxid.	Carbonic Acid.	Sodium Carbonate.	Water.
Na_2O	$+$	H_2CO_3	$=$
		Na_2CO_3	$+$
		H_2O	

As a rule, out of all the scale-forming material found in feed waters, none occurs so frequent, nor yet in such large proportion, as does carbonate of calcium; next in order carbonate of magnesium may be said to occur. Carbonate of iron occurs in limited areas and never in large quantities.

The carbonates of calcium and magnesium are very slightly soluble in water, and very rarely exist as such in quantities exceeding two grains per imperial gallon, and it is very rare that they are present in the water separately, as they usually exist in water together, and in this case the total held in solution never exceeds the maximum quantity of either which the water is capable of dissolving. This small quantity of dissolved solids would have but little effect in a boiler feed water, and draws our attention to a very important fact. If the carbonates of calcium and magnesium are, as stated, nearly insoluble in water, how is it that they predominate as scale-forming impurities and

are so often found in chemical solution in boiler feed waters in such large quantities?

If we turn back to the article on dissolved gases, we shall find that many gases are very soluble in water, and it is this fact that plays such an important part in explaining the presence of insoluble carbonates.

Wherever organic decomposition or combustion is taking place carbonic dioxide (CO_2) is being constantly evolved. This at ordinary pressures and temperatures exists as a gas, and is therefore a constant constituent of the atmosphere; it is also contained in the soil as a product of organic decay.

J. A. Wanklyn, in an excellent work on "Water Analysis," published in London, England, states that "in many natural waters there is more carbonic acid gas in some form or other than any other single foreign material." As already seen, carbonic dioxide is very soluble in water; some is absorbed by falling rain, and a still greater quantity as it passes through the soil. We have already noted the very wide distribution of the various carbonates in nature, and although the carbonates of lime and magnesia are nearly insoluble in water, they are very soluble in water containing carbonic acid.

The carbonates of lime and magnesia appropriate a portion of the carbonic acid equal in quantity to that already existing in combination with their oxides to form the carbonate, thus forming what is known in chemistry as a bicarbonate, according to the following equation:

Carbonate of Lime.	Carbonic Acid.	Bicarbonate of Lime.
CaCO_3	$+$	H_2CO_3
		$=$
		$\text{CaH}_2(\text{CO}_3)_2$

and

Carbonate of Magnesia.	Carbonic Acid.	Bicarbonate of Magnesia.
MgCO_3	$+$	H_2CO_3
		$=$
		$\text{MgH}_2(\text{CO}_3)_2$

Both the bicarbonates of lime and magnesia are very soluble in water, and the presence of carbonate of lime and magnesia in boiler deposits may then be explained as follows: The rain reaches the earth charged with a certain quantity of carbonic acid, and in passing through the soil takes up a still greater supply, and after passing through the earth rarely escapes contact with some of the carbonate rocks, which dissolve in it. After passing over these rocks and forming new solutions, the water again reaches the surface and forms the supply of our rivers, lakes or wells, from which we take our boiler feed supplies. These bicarbonates are very unstable salts, and are much more soluble in cold water than hot, owing to the fact that a rise in temperature drives off the excess of carbonic acid and the bicarbonate is as a consequence reduced to the carbonate, in which condition it is nearly insoluble. When a temperature of 180°F . is reached a large percentage of the carbonic acid is driven off, and the bicarbonate consequently suffers reduction to the carbonate, and at 290°F . the precipitation is complete. Thus we are readily enabled to account for the presence of the carbonate salts in boiler encrustation.

Next to the carbonates, the sulphates play an important part in feed waters. The sulphates of magnesium, sodium and potassium are all readily soluble in water, and although they play an important part in the treatment of boiler feed waters, need not be referred to here.

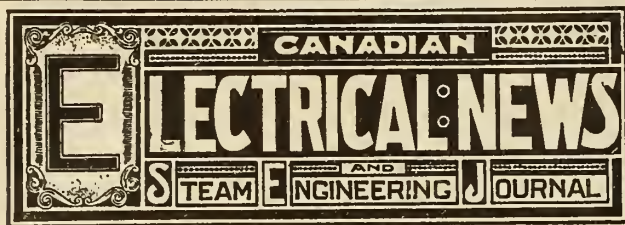
Probably no scale-forming salt has given more trouble or been more destructive to boilers than has sulphate of calcium. Sulphuric acids readily attack nearly the whole of the metallic oxides and especially those under consideration, forming sulphates and water, thus:

Calcium Oxide.	Sulphuric Acid.	Calcium Sulphate.	Water.
CaO	$+$	H_2SO_4	$=$
		CaSO_4	$+$
		H_2O	

Calcium sulphate or sulphate of lime is found in nature widely distributed, occasionally in the anhydrous form as anhydrite, and much more commonly as the hydrate known as gypsum. When gypsum is heated to about 240° to 250°F ., it loses a large proportion of its water of crystallization and becomes what is known to us as plaster of Paris. This product is, as we know, capable of taking up another portion of water and "setting" to a close, hard stony mass. The anhydrous sulphate is nearly insoluble in water, but the hydrated form dissolves fairly readily and up to about 120°F ., as the temperature increases the solubility increases. Above 212°F . solubility decreases very rapidly, and at 300°F . it becomes almost entirely insoluble. Unlike the carbonates the presence of carbonic acid gas has no effect upon its solubility, its solubility being entirely due to the solvent power of the water itself. When the hydrated sulphate of lime precipitates it loses a portion of its water of crystallization, and when it reaches the boiler plate the balance, and it is consequently converted into the anhydrous state, and this change in crystalline form is largely the cause of precipitates containing sulphate of lime being bound into such hard compact masses and forming such a troublesome scale.

As already stated, sulphuric acid occasionally occurs in streams, etc. If bicarbonate of lime or magnesia are present free acid will not exist until the salts of calcium and magnesium have been reduced from carbonates to sulphates. The same reduction takes place when water containing sulphuric acid is passed over limestone rocks, and since rain water has been shown by numerous chemists to contain traces of sulphuric acid, the presence of sulphate of lime is largely accounted for. The chlorides of the various metals under consideration are frequently present in feed water, especially sodium chloride, which is simply common salt. Since, however, the whole of the metallic chlorides we have occasion to refer to are easily soluble in water and do not form scale except in extreme cases, we do not require to refer to them at any length, particularly since we shall require to discuss them fully at a later stage, chiefly as to their effect on the scale-forming agents.

The oxides of silicon and aluminum are frequently found in scale, and when present in any quantity form a very troublesome scale. They are not easily soluble in water, but often occur in large quantities where muddy water is used without previous filtration.



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Correspondence is invited upon all topics legitimately coming within the scope of this journal.

The "Canadian Electrical News" has been appointed the official paper of the Canadian Electrical Association.

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Legal Rights of Telephone Companies.

JUDGE Cox of the Supreme Court of the District of Columbia has lately given a decision of much interest to telephone companies and telephone subscribers. An hotel keeper at Washington was threatened with the removal of his telephone if he continued to permit the free use of the instrument to his patrons. He applied to the court for an injunction to restrain the telephone company from carrying out their threat. While granting the injunction Judge Cox imposed certain restrictions upon the plaintiff as to the use which might be made of the telephone. One is that while boarders in the hotel may telephone for a baggage waggon, they are not entitled to use the instrument to order theatre tickets or stock reports. These restrictions are based on the fact that the guest in the hotel does not get free cabs, telegrams, newspapers, or boot shines. Judge Cox very correctly points out that "When the subscriber allows others to use his telephone it is an abuse of the time of the telephone operator. It is also an infringement on the rights of the Bell Telephone Company, which receives a royalty from the defendant. Furthermore it is an infringement of the rights of other subscribers. It is very annoying for a subscriber to call for a certain number and be told that the connection he wants is busy, that being due to the fact that a non-subscriber is using free of charge, the telephone with which connection is desired"

Canadian Electrical Association.

THE Committee on Legislation of the Canadian Electrical Association thought it advisable, notwithstanding the shortness of the late session of the Ontario Legislature, to make an attempt to secure a measure of relief to gas and electric lighting companies, from unfair and unjust municipal competition. With that object in view a short bill was prepared which came before the Municipal Committee. After discussion those representing the Association consented to a suggestion of the chair-

man and other members of the committee, that the matter should stand over for a year. The committee thought that in view of the early adjournment of the House, and the pressure of business consequent upon an unusually brief session, there was not time to give the bill the proper amount of consideration. The discussion, however, brought out the fact that there could be found no solid objection to the principle of the Bill, while on the contrary the injustice of the present law was brought into clearer prominence. The necessity and propriety of some measure of relief which will prevent the confiscation of electric light investments may be considered now to be generally admitted, and there is reason to hope will be forthcoming at the next session of the legislature. The electric light companies throughout the province, who are all more or less interested, should give the Canadian Electrical Association their hearty support in this movement.

Electric Lighting for Profit.

AN able paper on this subject was recently read before the Northwestern Electrical Association by Mr. Alexander Dow. The text of the paper was that at the present time the policy of electric light managers should be to sell electric energy to every accessible user, at the lowest price which will realize a fair profit on the capital invested. It was argued that the few who are still following old methods and asking high prices for energy are simply advancing the cause of municipal control. Perhaps the most important subject touched upon by Mr. Dow in his paper was that of supplying light and power from the same units. He believes the best practice of to-day is to furnish arc and incandescent lights, as well as motive power, from the same dynamos and mains, thereby greatly reducing the cost of plant and distribution lines. While this is a subject which should be considered in the original design of a station, Mr. Dow points out that there are instances where old stations have been re-arranged, with very satisfactory results. Only for railway work does he advocate the installation of separate units, giving as his reason that there has not yet been devised a satisfactory system whereby a supply of 500-volt current can be combined with a general lighting distribution system. In the winter season the load on street railways coincides with the heaviest load on the lighting system for an hour or so each day. Mr. Dow concludes his paper with a plea for greater educational work among electric light men, municipal authorities and municipal theorists.

Acetylene Gas.

IN view of the effort that is being made, principally by the eight or nine companies engaged in the manufacture of acetylene gas machines, to introduce acetylene gas throughout this country, we publish in this number the rules which have been adopted by the insurance authorities of Germany and Canada for regulating its use. A careful perusal of these rules should be sufficient without further argument to show the extremely dangerous character of acetylene, and it is well that the dangers attendant upon its use should be understood at this stage, when as yet it has come into use in but few places. We are surprised to learn that in one or two towns an effort is being made to displace the electric light by acetylene gas. We cannot imagine that the effort will be successful, but should the citizens of these towns be induced by specious arguments, and the novelty of the new light, to adopt

it in preference to the electric light, they will assuredly have cause to regret their action. A material that is not allowed to be kept within a building, even when gas machines of approved design are used, except at an additional cost for insurance of 10 cents per \$100 per year, or 20 cents per \$100 for a three years' risk, must indeed be dangerous in its character. Further than this the German regulations provide that persons engaged in handling the carbide should be free from heart and lung diseases and should wear a respirator and eye protectors. These two features of the regulations are sufficient to show the dangers attending its use. It is difficult to believe that a material which must be surrounded by so many safeguards will find extensive and permanent use. Certainly, no well conducted electric light concern need have any fear of successful competition from this source. We are not in a position to speak definitely with regard to the price at which acetylene can be supplied, but the fact that the Wilson Carbide Company at Merritton are contending in the courts for the privilege of operating their works on Sunday, on the ground that only by so doing can the business be conducted at a profit, and their statement that the operation of the works thus far has resulted in a deficit of some \$7,000, would seem to show that the cost of production is so great as to allow but a small margin of profit.

Efficiency of Motors.

COMPETITION in the manufacture of motors has been the result of some concerns turning out cheap work and of course inferior articles. It is very seldom the purchaser of a motor ever asks the efficiency, he being content to get a certain size for the lowest possible price, and taking the rest for granted. The result of this is disastrous to the company supplying the power—and instances of this kind are very numerous—the supply company getting the name of being extortionate in its charges, whereas the trouble is originally with the motor. We have heard of smaller size motors (from 15 h.p. down) taking as high as 4 e.h.p. for 1 B.H.P. This is certainly not as it should be, and shows room for improvement. Purchasers will pay a higher figure for motors when the efficiency is higher, and they will find that it pays ultimately when they are paying for their power by meter measurement. If, however, they are by "contract" and the contract is based, as is usually done, on the amount of machinery to be driven, it is only natural to expect a "boost" at the expiration of the contract if a meter has been put on as a check, which is done in all well-regulated plants. The customer would never think of the motor being the cause of the trouble, but he certainly thinks and does not hesitate to say the company is robbing him, whereas as a matter of fact he is robbing himself, for he is getting an E.H.P. for say 2 cents per hour and paying about 6 to 7½ cents per B.H.P. Let manufacturers settle down to making first-class apparatus giving the highest possible efficiency and they will find purchasers. If there were not any poor machines made none would be bought, and we are certain that the manufacturers themselves are largely to blame for this state of affairs.

Economy of Water Power.

WATER power is always assumed to be more economical than any other source of energy, since it is supplied naturally gratis. We think, however, there is considerable room for discussion on this point. The cost of installation, together with the purchasing of water and pole line

rights, brings fixed charges up to such a point as to make it very doubtful, indeed, whether power delivered from a water-driven plant for considerable distances can be done at a less cost than that produced locally by steam. Where water power is limited and a reserve steam plant has to be kept, the advantage is still more doubtful. Changing plants from steam-driven to electrically driven from some distant water power, should receive the most careful consideration, as no doubt is usually the case. Difficulties, such as breaking down of pole line, generators and turbines being disabled, etc., all tend of course to increase the risk. Certainly the chances of a shut-down are greater in the case of a distant plant—a most important consideration. Where there is a large load the cost per light per year may be reduced to such a figure as to render it an impossibility for water power to enter into the system if it has to be delivered from a considerable distance. This, however, can only be done by first-class apparatus, such as boilers, engines and generators. First cost, we regret to say, enters more into consideration with purchasers than it should do. This should be secondary, efficiency being the main point at issue. If a boiler maker supplies a boiler and guarantees an efficiency of 85% and fulfils same, it is surely worth a great deal more than one which will give only 60%. In how many cases does the efficiency of the boiler enter into consideration? This is a question worth pondering over. If an engine builder guarantees a 500 h.p. engine to run on 13 lbs. steam per h.p. hour, and fulfils his guarantee, this engine is a far better investment than one taking 26 to 30 lbs. and costing only one-half of the other. We believe there is an utter lack of attention on this point, and the sooner a thorough system of testing boilers and engines in steam and electrical plants is inaugurated the better. When this is done and old boilers and poor engines discarded, the question of substituting water power for steam is never likely to be a very serious one with local plants, especially when the water power is at some considerable distance and the power is generated in large quantities by the local plant.

SAFEGUARDS AGAINST ACETYLENE GAS.

THE dangers attending the manufacture, compression and liquefaction of acetylene gas are provided against in Germany in a series of rules issued by the Imperial Insurance Office, of which the following is a condensation:

RULES FOR EMPLOYERS AND FOREMEN.—Liquefaction of acetylene must be carried out apart from the manufacture and compression; but if the gas is compressed to eight or more atmospheres, the compression also must take place in a separate apartment. The apartments must be well lighted and ventilated, have doors opening outwards, and be heated only by steam or hot water. External sources of light only may be used; or, in urgent cases, safety lamps may be resorted to. The carbide must be kept in moisture-proof vessels, which vessels must be stored in well-ventilated dry apartments (not cellars). The vessels should be opened only as needed for immediate use. As little dust as possible should be made in breaking up the carbide; and persons engaged in the work should be free from heart or lung diseases, and should wear a respirator and eye protectors. The gas holder must be situated in an open, or in a well ventilated apartment away from the generating room, and it must be provided with a pressure gauge. An efficient washer must be placed between the generator and the holder. The gas must be generated by the gradual addition of carbide to a large excess of water, and not by adding water to carbide. Compression of acetylene to more than ten atmospheres pressure must only be carried out in strongly cooled apparatus. In the liquefaction of acetylene, the condensing vessel must be emptied at the close of operations, and the cylinders used for the conveyance of liquefied acetylene must have been tested to 250 atmospheres pressure, and have their contents signified on the outside—in white. Before and after filling, the cylinders must be weighed with precision, and no more than 1 kilo, of acetylene per three liters capacity (20.8 lbs. per cubic foot) be admitted. The charged cylinders must not be exposed to

heat. The cylinders and all apparatus which comes in contact with liquefied acetylene must be entirely free from copper, and sharp angles in valves and apparatus avoided.

RULES FOR WORKMEN.—Naked lights and lucifer matches must not be used in apartments of acetylene works and safety lamps must not be opened. In breaking lumps of carbide, as little dust as possible should be made. Water must never be added to carbide, and only small pieces of carbide added to water. The prescribed temperatures must be closely observed in the compression and liquefaction of the gas. The cylinders used for liquefied acetylene must answer to, and be filled in accordance with, the prescribed conditions. On opening a cylinder, take care the acetylene issues very gradually.

A copy of the rules must be hung in a suitable place in the apartment. Fines are imposed for breaches of regulations.

The following are the regulations governing the installation and use of acetylene gas, adopted by the Canadian Fire Underwriters' Association, November, 1897:

For each approved Standard machine installed and maintained in accordance with the following rules, in the building insured, or in any building connected therewith, an extra of 10 cents per \$100 for annual risks, and 20 cents per \$100 for three year risks must be paid on the building and its contents.

If the apparatus in the building insured, or in any building connected therewith, has not been approved by the association, or if it is not installed or maintained in accordance with said rules, double rates must be paid.

No charge to be made for an approved Standard machine when installed outside in a first class building (having no communication with the building insured), or in a building of any construction detached not less than 15 feet.

REGULATIONS.

1. No apparatus for generating acetylene gas shall be installed until that particular pattern of machine has been examined and approved by the association. Any manufacturer of such apparatus desiring to have the use thereof sanctioned by this association, must furnish the secretary with a copy of working drawings and specifications of materials used in making the machine, one of which he shall exhibit in full working order, and submit same to such tests as may be required by the inspector of the association. The expense of such inspection shall be paid by the manufacturer. If the apparatus is approved by this association, the manufacturer shall sign an agreement that all machines made and sold by him shall be shown by the drawings and specifications filed with the association.

2. Every generator shall be of suitable capacity, substantial construction and on approved principles, the interior parts easily and readily accessible for examination, double generating chambers required, as there is no means of telling whether carbide is exhausted and gas may give out after dark.

3. All danger of corrosion must be eliminated and no copper or any alloy thereof to be used in the machine.

4. There must be no possibility of escape of gas whilst the charge of carbide is being renewed.

5. In generators where the carbide is alternately dipped into, and raised out of the water, suitable precautions shall be taken to prevent the carbide being accidentally precipitated into the water, and thereby causing a too rapid generation of gas.

6. In machines where the pressure of the gas causes an inverted vessel to rise and fall inside of another that contains liquid, the clear space between the two shall be at least one inch all round, not only to secure free motion, but that the surface of the water may be plainly visible without the aid of a glass tube.

7. Liquid seals must be in their natural condition, not liable to be thickened by deposit of lime or other foreign matter.

8. The liquid seals (except those from which the gas is properly piped away) shall be of sufficient depth to resist any possible pressure of gas inside the generator, and in no position shall they be less than six inches.

9. The supply of water to the carbide shall be immediately and automatically cut off before the pressure of gas inside the generator exceeds three inches of water, and a properly protected water gauge, or gauges, shall be so placed as to show the actual pressure of gas inside the generator and gasholder.

10. Suitable escape pipes must be provided, through which the gas shall freely and safely pass from the generator and gasholder into the external air at a pressure not exceeding three inches of water, and before it becomes possible for it to escape by any other means.

11. The pipes for the conveyance of gas from the generator to the gasholder, and those for the escaping gas, shall be at least one inch internal diameter.

12. The apparatus must be located in a dry room, without artificial light or fire heat, and have good ventilation to the outer air near the ceiling.

13. The generator must be charged and the deposit removed by daylight.

14. The deposit, when removed from the generator, to be placed at safe distance outside the building, as the same may contain carbide that is not entirely decomposed.

15. The use of liquid acetylene or of gas generated from liquid acetylene is absolutely prohibited, also lamps from which gas is generated from carbide therein.

16. **STORAGE OF CARBIDE.**—None permitted inside building, except in generator room, and then only in air tight metal cases, each case to contain only one charge, and the total quantity shall be limited to the requirements for one week, and in no case exceed 50 lbs.



NEW WESTMINSTER LIGHTING STATION.

MUNICIPAL ELECTRIC LIGHT PLANT AT NEW WESTMINSTER, B. C.

[DESCRIPTION FURNISHED BY THE CITY AUTHORITIES.]

NEW Westminster, British Columbia, was the first city on the Pacific Coast—and one of the first in Canada—to adopt the principle of municipal control of electric lighting both for street and commercial purposes. It was not without a struggle, however, that the desired end was attained. Early in 1890 a private company came forward with a proposition to furnish the corporation with fifty 2,000 c. p. arc lights at a rate of 45 cents per night each. This would have cost the city over \$8,000 a year; but the number of lights required to light the city properly was at least 90, and these would have cost, at the same rate, in the neighborhood of \$15,000 per annum.

The question of the municipal control and ownership of the water and light franchises had already received a good deal of attention from the public, and New West-

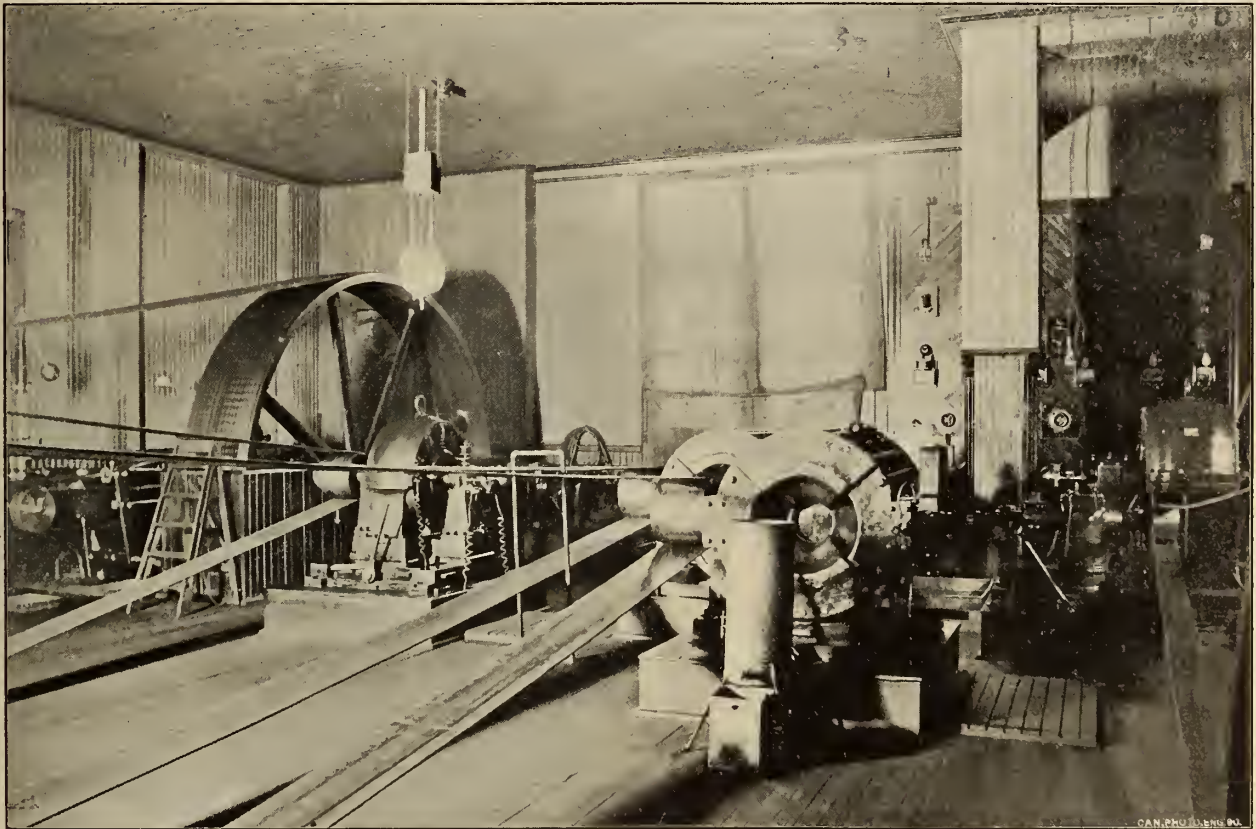
minster at this time had decided upon controlling the public water service. A system of waterworks was under construction and was soon afterwards completed at a cost of about \$450,000, which system is to-day one of the best on the continent. The city council of 1890 was composed of a set of thoroughly wide-awake business men, and they decided, with commendable promptness, in order to be first in the field, to proceed at once with an electric lighting system. Like the sentry who was ordered to "shoot first and challenge afterwards," the council, without proper legal authority, entered into

the necessary engagements for buildings and plant, and afterwards applied to parliament to legalize the expenditure, which was done. The result has been entirely satisfactory, and to-day the ratepayers of New Westminster would not, under any circumstances, permit the lighting franchise to pass out of the control of the corporation. The city is one of the best lighted on the continent, and the actual cost of street lighting to the ratepayers has been reduced to a mere trifle. The success of the enterprise was, of course, due very largely to the ability of the management, and to the hearty and generous support of the public.

When it was decided to proceed with the works, the Council's first step was to secure the services of a skillful electrician to superintend the construction. Mr. P. Bowler, an expert from the Royal Electric Company, of Montreal, was finally engaged, and the selection, as events have since proved, was a most judicious one. On the completion of the installation Mr. Bowler assumed full control of the system, and still holds the office of city electrician.

A substantial brick building, two stories in height, 60 x 100 feet, was erected in a central location for a lighting station. The ground floor was divided into two apartments,—boiler room 60 x 40 feet, and engine and dynamo room 60 x 60 feet—separated by a 12 inch brick wall. The upper story has been fitted up with the necessary appliances for repairs, which are all done on the premises, even to the re-winding of the armatures, by the regular staff, and so far the electrician has had no occasion to send any part of the electrical apparatus out of the building for repairs.

In 1890 the plant put in consisted of one 180 h. p. Reynolds Corliss engine, size 20 x 42; two Inglis 80 h. p. boilers, with one 150 h. p. feed water heater; one



NEW WESTMINSTER LIGHTING PLANT, SHOWING CORLISS ENGINE AND ARC DYNAMOS.

minster at this time had decided upon controlling the public water service. A system of waterworks was under construction and was soon afterwards completed at a cost of about \$450,000, which system is to-day one of the best on the continent. The city council of 1890 was composed of a set of thoroughly wide-awake business men, and they decided, with commendable promptness, in order to be first in the field, to proceed at once with an electric lighting system. Like the sentry who was ordered to "shoot first and challenge afterwards," the council, without proper legal authority, entered into

50 light 2000 c. p. arc dynamo, and one 650 16 c. p. incandescent dynamo. The engine is belted to a counter shaft, and the dynamos in turn are belted from the counter shaft. Forty 2000 c. p. arc lights were at once installed for street lighting, and ten were reserved for commercial purposes. The demand for incandescent lighting was brisk from the first, and within four months the incandescent dynamo was overloaded, with applications for light still coming in. The city was growing rapidly and the council of 1891 found itself compelled to increase the capacity of both the incandescent and street lighting

at once. The ratepayers did not hesitate to vote the additional sum required. The plant was increased by two additional 80 h. p. Doty boilers; one 150 h. p. high speed Doty engine; one 1500 16 c. p. incandescent dynamo, and one 50 light 2000 c. p. arc dynamo, with the necessary lamps. The number of street lamps was then increased to 90, and ten months later the incandescent system was again overtaxed.

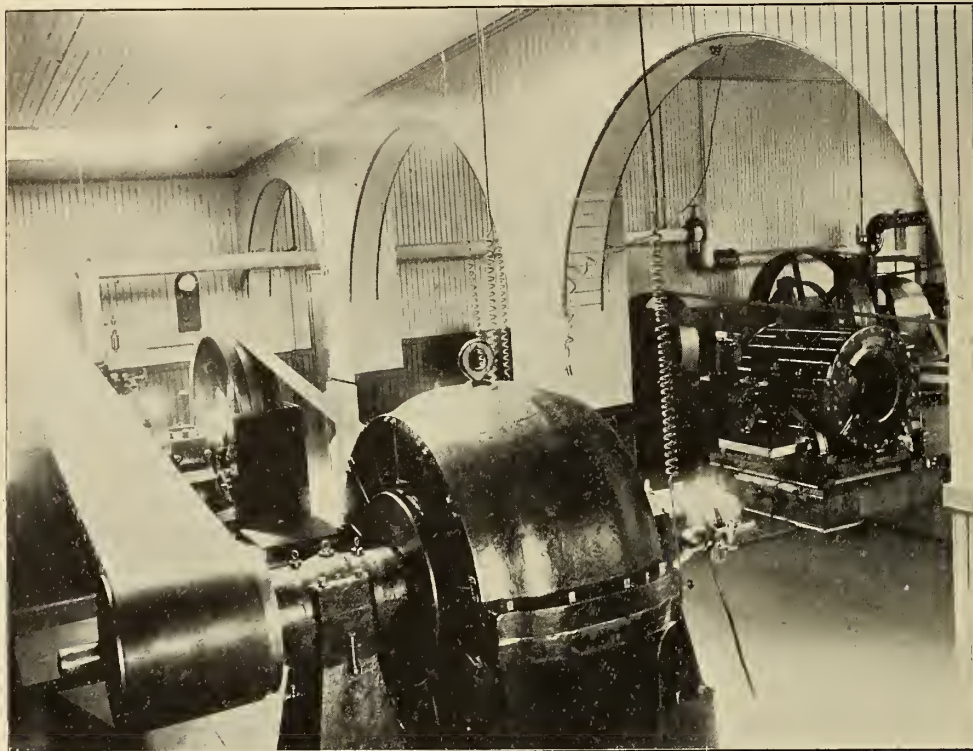
When the works were first established the rate for

poration by the Royal Electric Company, of Montreal, and has given good satisfaction.

The following figures will show how the revenue has increased annually since the inauguration of the system:

1891.....	\$10,520.67	1895.....	\$22,838.77
1892.....	18,221.15	1896.....	27,535.40
1893.....	22,167.39	1897.....	30,756.98
1894.....	21,585.05		

In 1897 returns were highly satisfactory. The revenue from private lighting amounted to \$19,642.73, and street lighting, with a rate of 35 cents per lamp per night, produced \$11,114.25, or a total of \$30,756.98, against receipts of \$27,535.40 in 1896. The expenditure in 1896 was \$21,327.61, and in 1897 \$21,388.22. Thus with an increased expenditure of only \$60.61 an increased revenue of over \$3,000 was produced. Let us now deduct the total expenditure from the total receipts, and a profit of \$9,374.76 remains. Deduct this profit from the charge for street lighting, and it will be found that street lighting in 1897 cost only \$1,739.49, or about five cents a night for each 2000 c. p. lamp. Another year of this progress, and not only will New Westminster be getting street lighting free, but there will be



NO. 1 ALTERNATOR, NEW WESTMINSTER LIGHTING PLANT.

incandescent lighting was fixed at \$1 per 100 ampere hours where meters were used, and a fixed rate of \$1.12 for 16 c. p. lights where meters were not used, both rates being subject to a discount of 20 per cent. for prompt payment. The works in 1892 were producing a larger revenue than anticipated, and it was considered advisable to reduce the rates for private lighting to 78 cents per 100 amperes, with the same rebate, and this rate still prevails.

The reduced rates produced an increased demand for

something over to go into the general revenue.

The 1897 expenditures were made up as follows: Interest, 5 per cent. on \$116,000; clerk, 12 months at \$35, \$420; electrician, 12 months at \$125, \$1,500; engineer, 12 months at \$80, \$960; assistant engineer, 12 months at \$65, \$780; dynamo tender, 12 months at



MR. P. T. BOWLER,
City Electrician, New Westminster, B. C.

light, and in 1893 the council was again compelled to reinforce the plant by adding another 1500 light machine and a 150 h. p. Ideal engine. Since then no additions have been made, although the still increasing demand will speedily compel a further extension of the system. The cost of the system as it now stands is \$116,441.62.

All the electrical apparatus was supplied to the cor-



SWITCHBOARD, NEW WESTMINSTER LIGHTING PLANT.

\$62.50, \$750; two firemen, 12 months at \$57.50 each, \$1,380; two trimmers, ditto, \$1,380; one cleaner, ditto, \$690; one wireman, ditto, \$690; one wireman, 12 months at \$40, \$480; fuel, 12 months, \$2,700; car-

bons, \$500; oil and waste, \$300; repairs and new plant, \$1,000; miscellaneous, \$2,058.22. The fuel used is mill slabs and sawdust delivered in the boiler room by the Royal City mills at the cost above noted.

His Worship Mayor Ovens, in his inaugural address to the city council on January 3rd, 1896, very accurately stated the present position of the electric lighting problem in New Westminster in the following words: "The rapid growth of our electric light business now brings us face to face with the necessity of either increasing the present plant or refusing new business. It would be most undesirable to check the growth of an enterprise which in a year or two promises to pay a handsome profit after giving us our street lighting free of cost. There are two ways out of the difficulty. The first is to add to the present plant; the second is to make use of some convenient water power and bring the current to the city by cable. By adopting the latter plan, the cost of maintenance would be reduced by one-half, and as we would then have an uninterrupted service day and night, the revenue could be largely increased by supplying motive power to factories, elevators, etc."

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

NOTE.—Secretaries of Associations are requested to forward matter for publication in this Department not later than the 28th of each month.

TORONTO NO. 1.

At the open meeting, Feb. 15th, Bro. Wickens continued his talk on the steam engine indicator, and at the close was tendered a hearty vote of thanks.

At the regular meeting the Legislative Committee reported that all the members of the Dominion government resident in Toronto had been written to asking their support for the Engineers' License Law and Boiler Inspection Act, which is to come up at the present session, and a number of them have promised their support. The regular open meeting will be held Tuesday evening the 8th. Mr. St. John has kindly consented to give a talk on the strength of boilers. The president requests a large attendance and invites all engineers to be present.

KINGSTON NO. 10.

A special meeting of Kingston No. 10 was held in Congress hall, on January 26th, 1898. It was called for the purpose of visiting the members of parliament, Mr. B. M. Britton for the city, and Mr. David Rogers for the county, re legislation. The following members of the association were present: President Simmons, vice-president Asselstine, past-president Donnelly, Bros. Hoppins, Blomely, Woodrow, Davis, Tandvin, Linton, Strong, Gascoyne, Selby, Derry, Bajus, Turnbull, sr., Tait and Orr. We also had with us certificated members of the Ontario Association, viz., David Leslie, R. McArdle, James Ross and George Hazlett, of Winnipeg branch. The members proceeded to Mr. B. M. Britton's office, where they were received and made welcome. Upon the arrival of Mr. David Rogers the business was then proceeded with by President Simmons presenting an address, together with a copy of the act, to Mr. Britton, after which Bro. H. Hoppins, in a few well chosen remarks, presented a copy of the address and the act to Mr. David Rogers. Both gentlemen made a very courteous reply. After a few questions were asked and answered regarding the working of the association, Mr. Britton said he would support the bill, and that he would also give any assistance he could to make it a success. Mr. Rogers said that he could see no objectionable feature in the bill, but he would not pledge himself until he made further enquiries. At a regular meeting held on the 3rd of February a resolution was passed that a hearty vote of thanks be tendered to Mr. B. M. Britton and Mr. David Rogers for the kind reception they gave the deputation of engineers, and also that a copy of the minutes of the special meeting be sent to the ELECTRICAL NEWS for publication.

JOHN L. ORR, Secretary.

ENGINEERS' EXAMINATION QUESTIONS.

As most engineers are desirous of qualifying for a first-class certificate, it is the intention to publish in this journal from time to time, explanatory answers to the questions that have been asked on recent examination papers by the Ontario Association of Stationary Engineers, Montreal City Inspector and other associations by whom a standard of qualification is required. It is hoped by this means to assist engineers in fitting themselves for examination. Herewith is given an answer to the first question asked on the examination paper of the city of Montreal:

QUESTION 1. What is the highest safe working pressure of a common horizontal tubular boiler, made of 1/2" steel, with an ultimate tensile strength of 60,000 pounds per square inch of section. Factor of safety, 5; double rivetted. Length, 14 feet, diameter, 66 inches, and 76 three inch tubes?

ANSWER: The strength of a boiler is the strength of its weakest part, which is evidently on the lines of rivet holes, where a certain amount of the entire plate has been removed by the punch or drill. Many eminent engineers, such as Fairbairn, Kirkaldy and Elder, have experimentally investigated this subject, and the mean results arrived at on boilers as usually made, were that with a double rivetted joint the loss of strength mainly due to the rivet holes, is 30 per cent. of the entire sheet, and with single rivetting 44 per cent. This increased loss of strength with single rivetting is due to a distorting leverage, caused by the tendency of internal pressure to bring the centre of the plates in line. In double rivetting this effect is greatly resisted by the increased lap of the joint. The above results, put in a better form for practical use, are, that the strength of a double rivetted boiler is 70 per cent. of the solid sheet, and if single rivetted 56 per cent.

In the question the factor of safety is 5. This means that the greatest tensile stress that the material of the boiler is to be subjected to when at work is one-fifth of the ultimate or breaking stress. This amounts to 12,000 pounds per square inch of section of the plate, of which, owing to the joints, 70 per cent. in double rivetting is the highest permitted, and 56 per cent. in single rivetting. Now, 70 per cent. or seven-tenths of 12,000 is 8,400, which is the greatest tension in pounds per square inch of plate section that is permitted.

The sectional area of 1/2-inch plates per lineal inch is one-half of a square inch. At a tension rate of 8,400 pounds per square inch, the equivalent rate per lineal inch of plate is 4,200, and this is the highest tension allowed. Leaving algebra and integration in the books, it can be practically proved that in a circular boiler shell the tension per inch in pounds on a longitudinal line, or a line parallel to the centre line of the boiler, is equal to the pressure per square inch multiplied by the half diameter of the shell in inches, and also that the tension on a ring line is exactly one-half of that, provided the head sheets are entire. But, by subtracting the surface removed for the insertion of flues or tubes, the proportion becomes still less. It is for this reason that in calculations on the strength of circular shells no attention is paid to ring lines. The question now takes this form: What number multiplied by 33 gives a product of 4,200? Dividing 4,200 by 33, the quotient is 127.27, which is the answer to the question in pounds.

Irrespective of the thickness of plate or the diameter of boiler, in calculating the safe working pressure of double rivetted boilers, with plates of 60,000 pounds tensile strength, the number 8,400 is, during the process, always arrived at, and hence may be used as a constant. The following table goes a step further, the constants being on the same basis, but in proportion to the thickness of plate, and all that is required to answer such questions is to divide the constant opposite the thickness of plate by the half diameter of the boiler in inches:

Constant for 1/4" sheets	2100
" " 3/8" "	2625
" " 1/2" "	3150
" " 5/8" "	3675
" " 3/4" "	4200
" " 7/8" "	4725
" " 1" "	5250
" " 1 1/8" "	6300
" " 1 1/4" "	6825
" " 1 1/2" "	7350
" " 1 3/4" "	8400

Examples: What is the highest safe working pressure of a boiler of the above description, 42 inches diameter and plates 1/4" thick? Constant 2100, divided by 21, gives 100 pounds.

What is the highest safe working pressure of a boiler of the same description, 72 inches diameter and plates 3/4" thick? Constant 6300 divided by 36, gives 175 pounds.

If these boilers had been single rivetted the base constant would be 6720 instead of 8,400, and in the first example the highest allowed pressure would be 80, and in the second 140.

A valuable addition to engineering literature is the Engineers' Manual, compiled and issued by Toronto branch No. 1 of the Canadian Association of Stationary Engineers. The book bears evidence of being carefully prepared, and the many tables and other valuable data contained therein has apparently been selected with a view of furnishing to Canadian engineers a work that would be of every-day service. A special feature is the electrical department.

THE INDICATOR.*

By A. M. WICKENS,

[No. 3.]

MANY of you will remember that in our first "Indicator" talk, we examined the instrument and attempted to show how it was constructed, what were the particular functions of its different parts, and the necessity of keeping all in perfect order. Our second talk took the form of applying our indicator to an engine, with piston and valves tight and valves correctly set, and I have no doubt but that some of you will remember the appearance of the diagram we made. For this evening we will take up the reading of the diagrams, and the application of the hyperbolic curve to them—what is known as Boyle's law, or the law of the expansion of gases.

In this the pressure of a gas at a constant temperature varies inversely as the space it occupies, or in other words, double the volume, and you reduce the pressure one-half. This action is plotted out upon the diagram in the shape of a curve, and where everything is correct the steam expansion curve should follow very nearly to the theoretical one. This can only be attained when the engine and valves are in perfect order; and the steam should not contain more than 2 per cent. of moisture. It is not possible to read a diagram correctly without applying this curve to it; even if you know from the appearance of the diagram that something is wrong, you cannot tell how bad it is without applying this curve. One of the greatest troubles in applying the curve is that we do not know the volume of our clearances in our cylinders, for to be really correct it is necessary to know the amount of clearance; for instance, if we apply the curve regardless of clearance it would start from the wrong place and finish the same, and if the clearance was 4 per cent. of the piston displacement, our curve would be that much out of place, which would lead us to a wrong conclusion. If we intend to figure the water consumption as accounted for by the indicator, it is absolutely necessary to take the clearance into the problem.

There are several ways in which the curve may be put upon the diagram, one by figuring the pressure for the different volumes, and another by geometrical means. I will apply both means to the same card, and we will see how they come out. In all calculations and measurements in connection with the expansion of steam, it is necessary to work from a line of perfect vacuum; this line you can put upon any card by measuring below the atmospheric line with a scale of the spring used to take the diagram, 15 lbs., then from this line we measure or figure.

Take diagram No. 1 upon the board; the cut-off occurred at

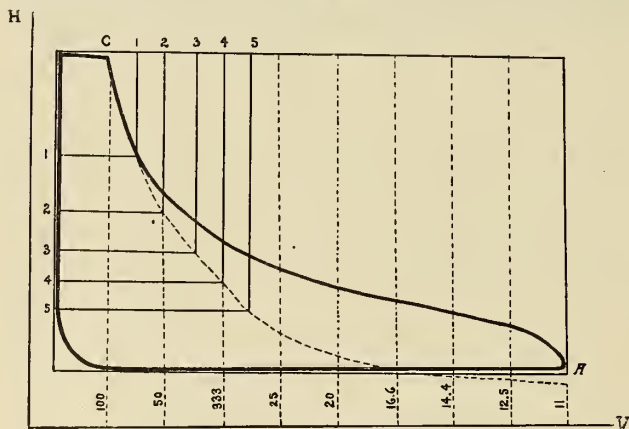


DIAGRAM 1.

one-ninth of the stroke. The spring used to take this diagram was a 16, so that each sixteenth of an inch represents 1 lb.; now, fifteen-sixteenths of an inch below the atmospheric line, marked A, we draw another line parallel to it; this is the line of perfect vacuum, and all our work must be done from it. We now apply the scale, and measure from it to the top of the diagram, and find we have $6\frac{1}{4}$ "—this represents just 100 lbs. pressure. We had this pressure when the steam valve closed at one-ninth of the stroke; then at two-ninths of the stroke we would have 50 lbs., at three-ninths 33.3 lbs., at four-ninths 25 lbs., at five-ninths 20 lbs., at six-ninths 16.6 lbs., at seven-ninths 14.4 lbs., at eight-ninths 12.5 lbs., and at the finish of the stroke 11 lbs. pressure. Now, if we measure up from the line of perfect vacuum each of these heights with our scale, and draw a line for each, the curve will just touch the end of each ordinate. If we want to put the curve on graphically, erect a line to represent the clearance, put the line of perfect vacuum on same as before, assume some point where the two lines are to coincide, (say at C, the point of cut-off), draw a line at right angles to the vacuum line that cuts this point, then divide the card up into any number of spaces, making them closer together at point of cut-off. Now, from the intersection of the lines H and V at O, lay your straight edge to point I, and mark upon the line C where it crosses; do the same at each of the other points, then draw lines from each of these points at right angles to the line H, and where they meet the ordinates is the place to locate the curve (do this in two colors). You will therefore see that the expansion curve follows almost the same points by either method.

We can also figure from the diagram the amount of water used per h.p., or we can measure the steam at any point in the stroke, and from that compute the amount of water used (not all). Now,

if we measure the steam just before the exhaust valve opens, we will have the amount of water used.

We will take diagram No. 2, and add the clearance space to the diagram. This clearance we add to the volume of the cylinder up to the point we have picked upon for our measurement (one clearance only). Multiply the volume of cylinder up to point to be measured by the pressure at that point, measured from the line of perfect vacuum. The weight of a cubic foot of

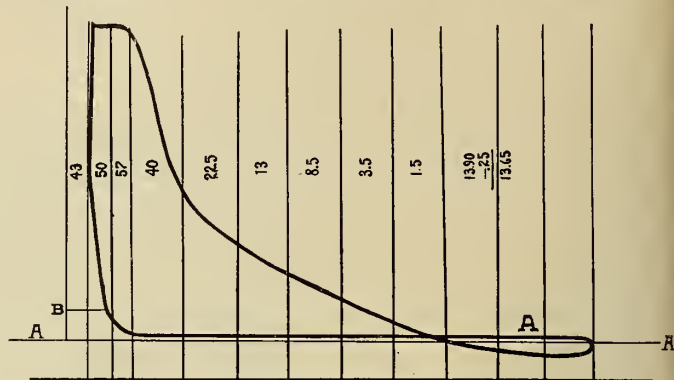


DIAGRAM 2.

steam of any pressure can be obtained from any of the hand books having such a table. This diagram was taken from a Corliss engine, cylinder 16 x 30, running 125 revolutions per minute. The area of this piston is 198.6 square inches. The clearance is four per cent., and amounts to 248 cub. inches. We will fix the point A to be measured, as it is just before the exhaust valve opens, and it is .9 of the stroke, or 27 inches. The volume of steam up to this point is

$$\frac{198.6 \times 27 + 248}{1728} = 3.2466 \text{ cub. ft.}$$

The pressure at A is equal to 13.5 lbs. and the weight of a cubic foot of steam at that pressure .035 of a pound, so we have $3.2466 \times .035 = .11363$ of a lb. This is the weight of the steam used each time the cylinder is filled. From this is to be deducted the amount of steam saved by compression in closing the valve before the stroke is finished. We will take a point on the diagram say at B; this point is such that we know the exhaust valve has closed, and we find that it represents about 1.28 in. on the return stroke—this is about three-eighths of an inch and is bearing the same proportion to .9 as 1.28 is to 30 inches, the length of the stroke.

$$\text{We then have } \frac{198.6 \times 1.28 + 248}{1728} = .29 \text{ of a cub. ft.}$$

The pressure at this point is just 20 lbs. and the weight of a cub. ft. of steam at that pressure is .0511 of a lb.; this multiplied by .29 gives us .01482 of a lb. The weight of steam accounted for per stroke is $.11363 - .01482 = .09881$ of a lb., and the quantity per hour is $.09881 \times 250 \text{ strokes} \times 60 \text{ min.} = 1482.15$. Now, how much water per h.p. is this? The constant for this engine will be

$$\frac{198.6 \times 625 \text{ ft.}}{33,000} = 3.76$$

The M.E.P. upon the card is 13.65, hence we have $13.65 \times 3.76 = 51.32 \text{ h.p.}$, and the water per h.p. per hour will be

$$\frac{1482.15 \text{ lb. water}}{51.32 \text{ h.p.}} = 28.8 \text{ lb. water.}$$

We will now compute another diagram from the same engine, No. 3. We use the same constants. The pressure at .9 of the stroke is 26.7 lbs., and the weight per cubic foot is .067 of a lb.,

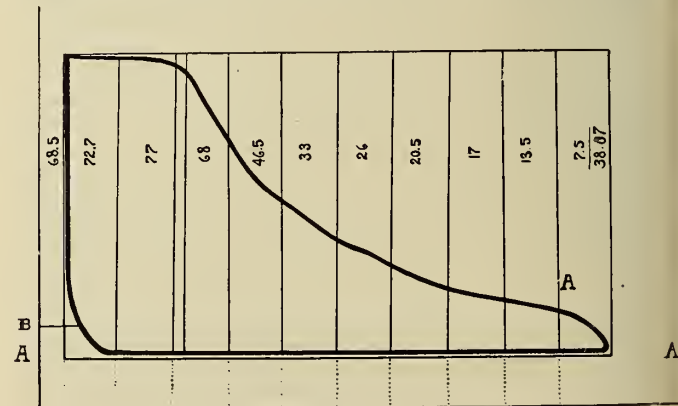


DIAGRAM 3.

then $3.2466 \times .067 = .2175$ of a lb. The steam saved measured same as before, 20.2 lbs., the weight is .0513 of a lb. Now $.29 \times .0513 = .0149$, and $.2175 - .0149 = .2026$ of a lb. per stroke. Then $.2026 \times 250 \times 60 = 3040.2 \text{ lbs. of water per hour.}$ Our M.E.P. in this case is 38.07; this multiplied by $3.76 = 143.143 \text{ h.p.}$, then $3040.2 \div 143.143 = 21.24 \text{ lbs. water per hour per h.p.}$, or a gain of as 4 is to 3.

By this you will see that the later cut-off is very much cheaper than the earlier one; and it is safe to say that all engines are wasteful at early cut-off, or light loads, and that every cylinder gives us the best economy when the load is reasonably heavy and the cut-off occurring at about one-third of the stroke.

[The diagrams used were taken in actual practice, and for the purpose of the lecture were enlarged to double their original size. As they appear herewith they are about one-half the original scale.—THE EDITOR.]

* Paper read before Toronto Association C.A.S.E., February 8th, 1898. (For second paper see ELECTRICAL NEWS for December, 1897.)

KINGSLEY WATER TUBE BOILERS.

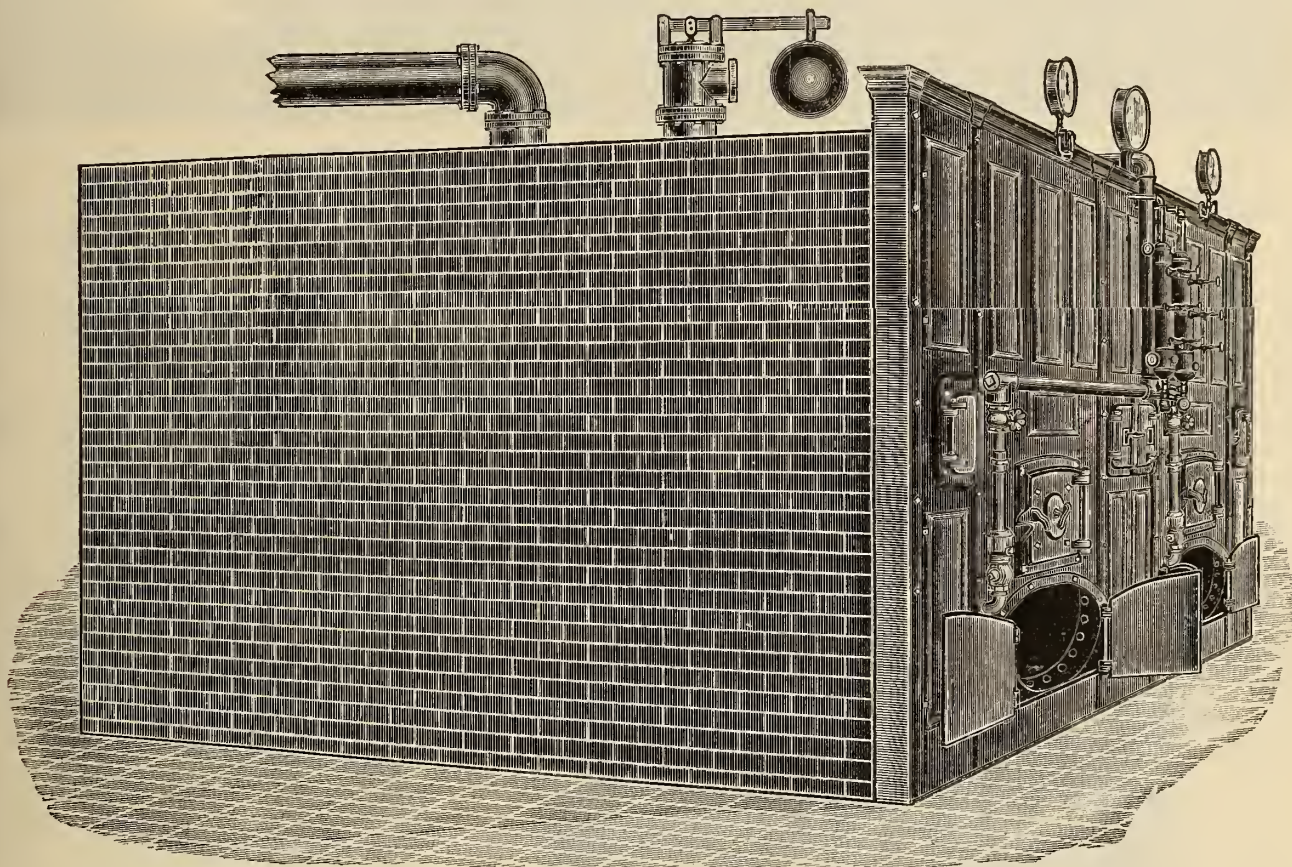
THE Kingsley patent water tube boilers, herewith illustrated, are constructed with two shells, an outer and an inner. The outer shell has vertical parallel sides and semi-circular top and bottom. The inner shell is fixed parallel to the sides and bottom of the outer shell by means of two flanged heads and numerous stay-bolts, leaving a uniform space about four inches wide between the two shells, extending the full length of the boiler. The crown sheet is horizontal, and extends continuously the full length of the boiler. It is flanged down three inches along each side for its entire length, and forms the top of the inner shell by being riveted to it along each side.

The tubes are threaded at their upper ends with standard pipe threads, and are screwed into the crown sheet. The bottom ends of the tubes are plugged with $\frac{1}{4}$ inch iron and are then welded solid. The tubes are made of standard 2 inch iron lap-welded pipe. They are short enough in the fire-box to leave an ample combustion chamber, and are longer behind the bridge wall. Any tube can be readily screwed in or out of the crown sheet without touching any other tubes.

The crown sheet is strongly stayed by stay-bolts screwed simultaneously, at various angles, into the semi-cylindrical top of the outer shell and into the crown sheet. These stay-bolts and those connecting the two shells are headed on each end. The parts of the two flanged heads forming the ends of the steam chamber are likewise stayed by rods screwed simultaneously into each, these rods being headed at each end or fitted with nuts.

or sediment, but, on the contrary, we think they are brighter than new." Hundreds of tubes have been screwed out and examined for sediment, in various parts of boilers which have been running for different periods, and have been found perfectly clean; in fact, any scale formed in manufacturing the tubes appears to be loosened and removed by the ebullition and rapid currents when the boiler is under steam. After such investigations there can be no reasonable doubt on this point. The reason for this exceptional cleanliness of the tubes is clear when we consider the construction of the boiler. The feed water, entering at the front of the boiler, between the shells, below the level of the grate-bars, in passing up becomes intensely heated before reaching the crown-sheet. It is well known that water, heated to a few degrees above the boiling point, parts with most of its impurities, as mud and carbonates of lime; and at a temperature of about 300 degrees Fahrenheit, equal to 52 lbs. steam pressure, it can no longer retain in solution the sulphates of lime, magnesia, etc., which form the much-dreaded scale in boilers. In this boiler these impurities, being separated by the intense heat, precipitate into the space between the cells, at the bottom of the boiler, where the heat is not sufficient to bake them into scale, and whence they can be washed out occasionally through the hand holes. This boiler is, therefore, by its construction, a perfect feed-water purifier, and no sediment or scale can gather in the drop tubes, because only purified water reaches the crown-sheet from which the tubes are supplied.

The boiler, being internally fired, has the fire-box entirely sur-



REPRESENTING TWO KINGSLEY WATER TUBE BOILERS OF 150 H.P. EACH.

The water is contained in the tubes and in the space between the shells, and extends up a few inches over the crown sheet. As this water service extends unbroken for the full length and width of the boiler, no rapid fluctuations of water level can take place, although the boiler is a very rapid steamer. It is possible to supply any capacity of water or steam space by extending the outer shell upward above the level of the crown sheet to any desired height. It is sometimes desirable to thus increase the steam space where large volumes of steam are required at one time, which occurs in various industries.

Regarding the construction and efficiency of this boiler the manufacturers say: No steam drum is used on these boilers. This is claimed to be an advantage over most water tube boilers, as well as many other types, as a steam drum elevated far above and away from the hottest fire can of itself act only as a condenser, as it is the tendency of steam to cool and condense immediately on leaving the direct action of the fire. In the Kingsley boiler the tubes, being vertical and short, liberate steam very freely, and without friction or impediment, which in all water tube boilers with inclined tubes causes a large percentage of water to be carried up with the steam. This is also one reason why this boiler produces dry steam even under the heaviest forcing.

By those who have not investigated, an argument may be advanced regarding the deposit of sediment in the tubes. This, the manufacturers claim, can conclusively be answered by referring to boilers which have been in use for upwards of ten years. One of these, in Chicago, being fed on the dirtiest of feed waters, has been in use for nine years. The users, a short time ago, wrote: "We have never had any trouble with the tubes filling with scale

rounded with a water-jacket. The incandescent gases from the fuel, passing up among the short tubes in the fire-box, are drawn backward among the long tubes to the end of the boiler, whence they divide and return, half on each side, between the outer shell and the brick casing towards the front of the boiler. From this point the now nearly exhausted gases can either be carried by means of a saddle over the front of the boiler direct to the chimney, or they can pass down into a flue under the boiler along to its back end, and thence to the chimney. There is no appreciable difference in economy of evaporation between these two methods of circulation of the gases. The tubes are "staggered" in the crown sheet and are spaced at such distances that the gases which pass zig-zag and strike each tube at right angles, while being confined on all four sides by the water-jacketed shell of the boiler, lose nearly all their available heat before they are returned on the sides. For this reason this boiler can be operated also as a locomotive boiler. The gases are passed out of the chimney only sufficiently hot to ensure a good draft.

This boiler requires the same size of chimney as any other type of boiler. For hot water heating for buildings there is no change in the construction of the boiler, the steam space being simply filled to the top with water. The fuel economy is the same as for steam purposes. The circulation of the water is the most direct that can be desired, as there is a continual uninterrupted rise from bottom to top of the boiler.

For marine purposes there is no change in the essential design of the boiler, the difference being in details and setting, as the brick casing could not be used. It has been installed for the

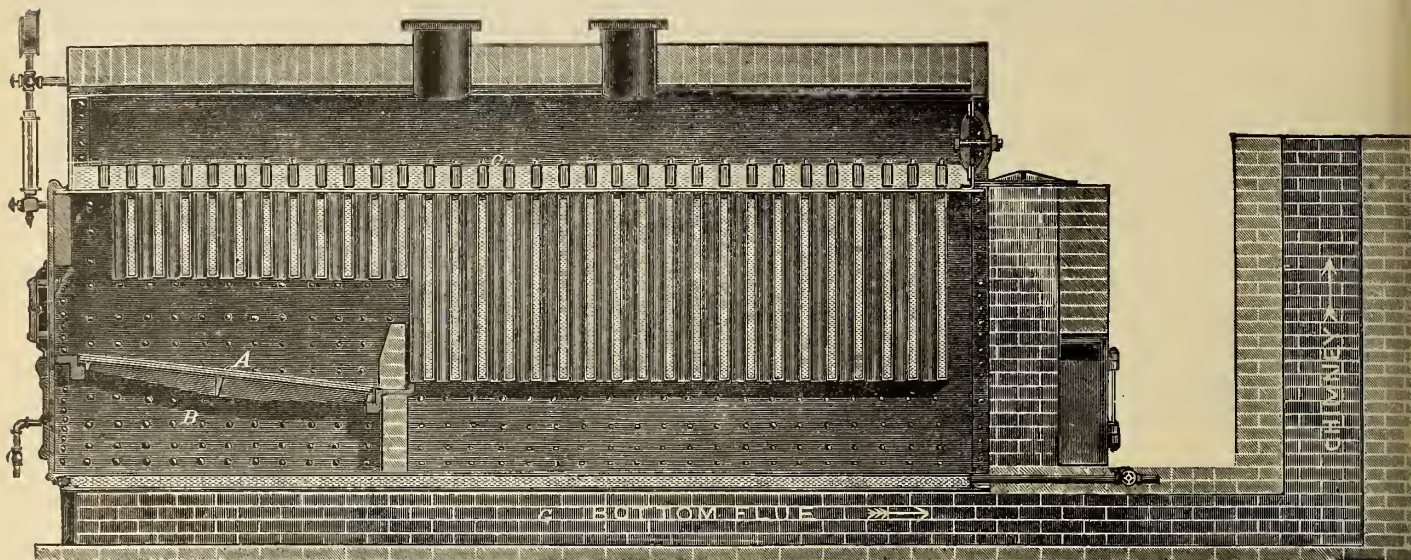
highest pressures, and is as easily cleaned and as durable as any boiler made.

The economy of installation is apparent when we note that this boiler occupies one-third less ground area than the other ordinary types of horizontal water tube boilers or the return tubular boilers, and less than one-half their cubic contents. It requires only 6½ feet in height. The brick casing is used only for the

from its construction. The advertisement of this boiler will be found on another page.

TRADE NOTES.

The Montreal Electric Co. have recently removed to more commodious premises at No. 1898 Notre Dame street.



LONGITUDINAL SECTION, KINGSLEY WATER TUBE BOILER.

return gases, and hence never requires renewing. As there is no fire-brick furnace to renew periodically, the repairs are reduced to an absolute minimum.

It is not necessary to refer to the exceptionally high evaporative economy of this boiler, as this could be readily predicted

The Richmond County Electric Co. has purchased a 60 k.w. S. K.C. two-phase generator from the Royal Electric Co.

The Buckingham Reduction Company, of Buckingham, Que., is installing a 200 k.w. power generator. The order was given to the Royal Electric Co.

The Ossekeag Stamping Co., of Hampton, N. B., has purchased from the Royal Electric Co. a 200-light incandescent plant for lighting their works.

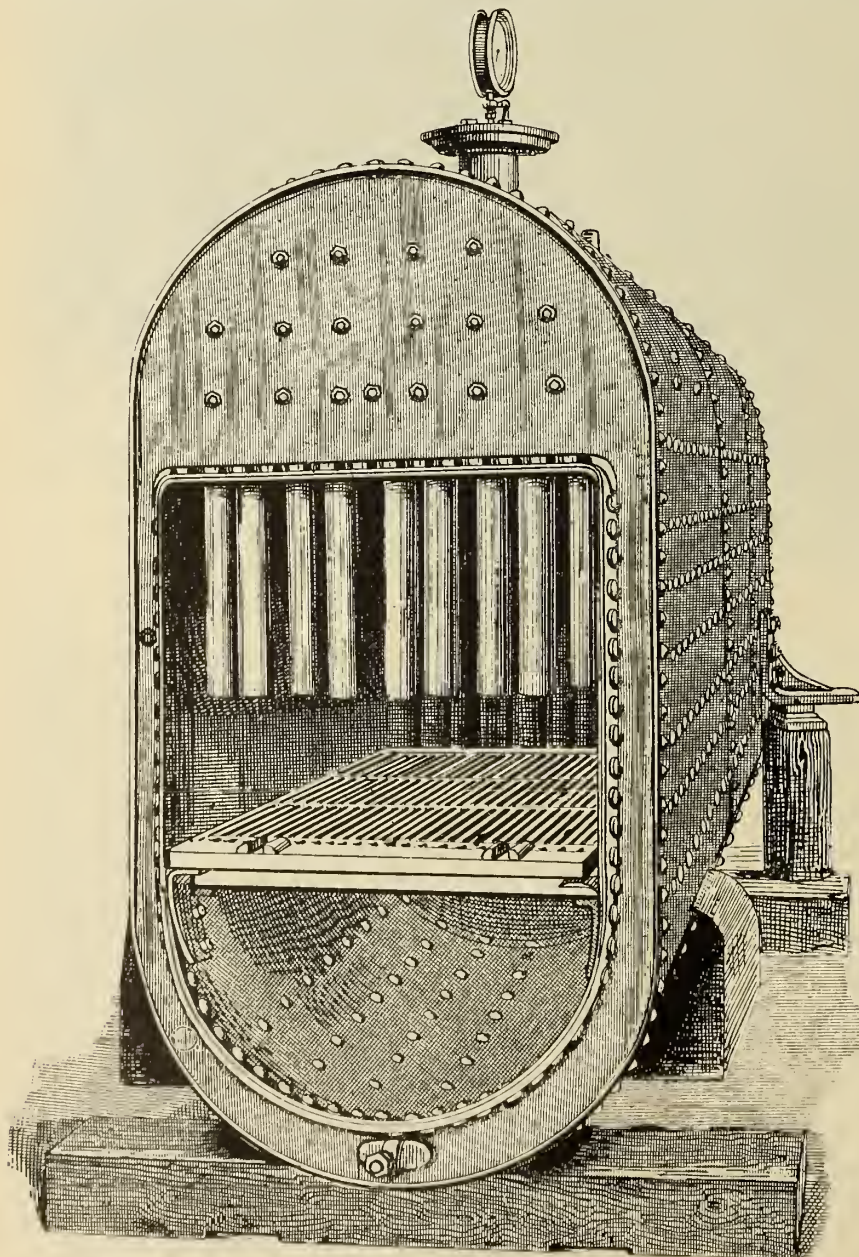
W. B. Davey will immediately commence operations for the lighting of Grand Forks, B.C. The order for the electrical machinery complete, including a 1,500-light alternator, has been given to the Royal Electric Co.

The T. & H. Electric Co., successors to Kay Electrical Mfg. Co., report recent sales of electric motors from 1 to 15 h.p. to the following firms: Norton Mfg. Co., Max Bernstein, Leitch & Turnbull, Bain & Sache, Electric Light & Power Co., G. H. Meakins, Domestic Specialty Co., Tolton & McKay, City Brass Foundry, Hand & Teale, Post-Office, Geo. D. Membury; also a 20-light dynamo to Bain & Colville, a 400 gal. plater to the Ontario Plating Works, and a 150 gal. plater to D. Moore & Co., Limited.

A very satisfactory statement is presented by the annual report of the Canadian General Electric Company for the year 1897. It shows the company to be practically free from debt, and to have assets of \$1,278,258.47. Dividends at the rate of six per cent. per annum were paid 30th June and 31st December, and the sum of \$40,000 was carried forward to reserve fund. The volume of business during the year was exceptionally large, while the value of overholding contracts in process of completion is more than \$100,000 greater than at the close of the previous year.

The Packard Electric Co., of St. Catharines, have established a club house and recreation grounds for the use of their employees. The club house consists of two rooms finished in natural wood oiled, and with a large old-fashioned fire place. The grounds are extensive, and have a rink for winter sport, and a field for lacrosse, etc., for summer sports, also provisions for bathing. Mr. E. E. Cary, manager of the company, was elected Hon. President; Mr. Bingay, president; Frank Adams, vice-president, with a complete staff of officers. Suitable by-laws were adopted. It is gratifying to record this evidence of friendly relationship between employers and employees.

The contract for street lighting in the town of Lindsay, Ont., expires on May 1st next, and a resolution has been passed in the Council authorizing the Fire and Light Committee to obtain particulars as to the cost of an electric light plant to be operated by the town.

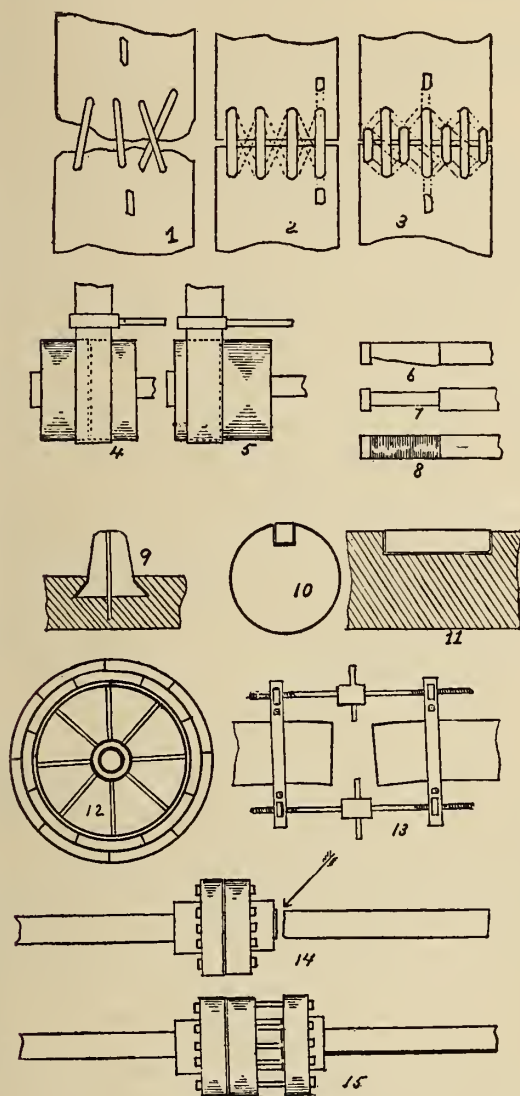


FRONT END VIEW OF NAKED (KINGSLEY) BOILER READY FOR WATER TEST.

POWER AND TRANSMISSION KINKS.

IN order to get the most out of any power transmission, the belting and all mechanical parts must be run to best advantage. If belted with a loosely laced belt like that shown in Fig. 1, the system will not run well, as the splice, being open, will slip upon the pulleys. The samples given in Figs. 2 and 3 show the plan of procedure which may be followed by the crosses on the back which are represented by the dotted lines. By thus making good, substantial unions that draw the butts of the belt together evenly and securely, less trouble will be had regarding the driving mechanism.

Do not run the belt too tight, as it will strain the bearings, cause friction, and consequently there will be loss of power. If too loose it will be likely to slip on the pulleys and cause loss of time as well as uneven work. It should be slack enough to be readily transferred from the tight to the loose pulley without excessive strain on the shipper. I have often found a machine doing poor work owing to the belt shipper being



set as in Fig. 4, in which the belt runs only partly on the tight pulley. Set it to run clear over on the pulley as in Fig. 5.

When a shaft is worn down as shown in Fig. 6, take it to the shop and turn it down like Fig. 7, then wind with steel wire as represented in Fig. 8, and a fairly good job will result.

When a cog breaks off of a gear, shape a new cog and dovetail it in, in the manner shown in Fig. 9, and insert a steel pin to prevent the cog from working side-wise. When a bearing throws oil in a place where it is desired that no drippings shall fall, cut a key-way in the centre of the bearing, about half the width of the box, and put in a felt pad as shown in Figs. 10 and 11; the pad absorbs the oily matter.

A lag pulley with wood is shown in Fig. 12, by bolting on sections of pieces cut to correct size to form a smooth surfacing. On the surface put a cement composed of two pounds of black pitch, two pounds glue,

one pound linseed oil. I have often travelled far to some mill or shop in response to a call from the proprietor, who has written to the makers of his new machines to the effect that the same do not work right, and upon arrival at the factory have discovered the cause, not in the machines themselves, but through some defect of setting up or starting. The pulleys, for instance, are sometimes the whole source of the trouble through being too small. The builders of the machines cannot tell just what size pulley to furnish always, consequently the selection of the driving pulley often falls to someone at the mill. High speed is the aim nowadays, and yet pulleys of but six or seven inches too small in diameter are frequently used to drive machines. This has many bad effects on both machine and belt. If the pulleys were larger in diameter, the results would be much better. The writer has often proved this to manufacturers by lagging up the driving pulleys on the shaft in the manner shown.

A good belt tightener for large belts is shown in Fig. 13, consisting of the two double end bolts at either side, arranged in the ordinary way, but threaded right and left, so that when turning the centre pivots, both ends of the belt are drawn toward each other simultaneously.

A shaft recently broke short off near a coupling, as shown in sample 14. We desired to run the mill until Saturday night, and as the shaft would not bear shortening, we put another coupling on the broken end, keyed it firmly, and inserted bolts clear through from the former couplings, as shown in Fig. 15, and the mill was kept running.—Power and Transmission.

NEW ENGINEERING SOCIETY.

THE members of the engineering staff of the Royal Electric Co., Montreal, have formed an association, to be known as the Royal Electric Engineering Society, the primary object of which is the advancement of knowledge in engineering subjects. At the inaugural meeting on February 14th a constitution was adopted and officers nominated. The membership includes some fifty charter and associate members and twelve honorary members. The meetings are to be held every two weeks from October 1st to April 30th.

The first regular meeting of the society was held on the 24th ultimo, at which officers for the current year were elected as follows: Honorary president, Mr. Wm. H. Browne, general manager Royal Electric Company; president, W. M. Bucke; vice-president, W. T. Dix; corresponding secretary, R. F. Morkill; recording secretary, W. G. Angus; treasurer, L. A. Howland; librarian and curator, F. Cushing; committee, J. Burnett, L. Mudge, K. B. Thornton.

The Auburn Power Company at Peterboro' have ordered a direct connected sub-station unit from the Canadian General Electric Company, consisting of a 75 h.p. induction motor direct connected to a three-phase induction motor. From this outfit current will be supplied at 500 volts to small power users throughout the town of Peterboro', it having been found that the high price of induction motors prevented their general use.

The General Engineering Company of Ontario, Limited, have during the last month purchased the patents and assets of the Weeks-Eldred Co., of Toronto. The capital has been increased to \$40,000. J. L. Caverhill, Montreal, has been elected president, and James Milne vice-president and general manager of the new company. The company have closed orders for the equipment of the steamer North King, of Kingston, and Boon's dredge, Collingwood harbor, also the Kingston penitentiary.

The Canadian General Electric Company have closed a contract with the E. B. Eddy Co., of Hull, for a 500 and 350 light multipolar direct current generator for lighting their mills at Hull. With these machines they will install standard marble panels containing instruments of the latest type. The contract also covers the supply of material for the wiring of the place in strict accordance with the latest requirements of the Fire Underwriters.

Mr. G. O. S. Conway, of Stonefield, Que., is said to have been successful in forming a company to develop the water power at Grenville and to erect a pulp mill in connection therewith. The scheme includes the installation of an electrical plant for the purpose of lighting the Carillon and Grenville canals, the villages of Carillon and Grenville, and the town of Hawkesbury, and also to furnish power for the proposed electric railway to operate on the north shore of the St. Lawrence river. It is expected that the final negotiations will be completed in about three months. Exemption from taxation will be granted by the town, and also a bonus of \$10,000.

What must be the diameter of a double-acting duplex steam pump making 100 strokes per minute and having a stroke of four inches to comply with above requirements?

$$\begin{aligned} 518.4 \div 60 &= 8.64 \text{ cu. feet per minute;} \\ 8.64 \div 100 &= .0864 \text{ cu. feet per stroke;} \\ .0864 \times 1728 &= 149.3 \text{ cu. inches, required contents of pump;} \\ 149.3 \div 4 &= 37.325 \text{ cu. inches, required area of cold water piston;} \\ 37.325 \div .7854 &= 47.5, \text{ and} \\ \sqrt{47.5} &= 6.88 \text{ inches, required diameter of pump piston,} \\ &\text{or say, } 6\frac{7}{8} \text{ inches.} \end{aligned}$$

Then, to safely comply with the conditions set forth, we shall require a duplex steam pump making 100 displacements per minute, with a 4-inch stroke and a cold water piston diameter of 6 $\frac{7}{8}$ inches.

MISCELLANEOUS QUESTIONS.

To find extra pressure required to discharge water from a given orifice:—

Formula:

$$\frac{T^2 D^4}{2000000 d^2 B^2}$$

Where T=travel of plunger in feet per minute,
D=diameter of plunger in inches,
d=diameter of delivery valve,
B=breath of opening or lift in inches.

Example: The cold water piston of a pump is 4 inches in diameter and has a travel of 150 feet per minute. The delivery valve is 2 $\frac{1}{2}$ inches in diameter and has a lift of $\frac{1}{4}$ of an inch. What extra pressure is required to discharge the water?

$$\begin{aligned} \frac{T^2 D^4}{2000000 d^2 B^2} &= \frac{150^2 \times 4^4}{2000000 \times 2.5^2 \times .25^2} = \frac{5760000}{781250} = \\ 5760000 \div 781250 &= 7.37 \text{ pounds.} \end{aligned}$$

To find velocity at which water will travel through the discharge pipe of a pump. The velocities are in inverse proportion to the area, or what amounts to the same thing, the velocities are in inverse proportion to the square of the diameters.

Then for the purpose of determining the ratio of velocity between any two pipes we may construct the following formula:

$$\frac{D^2}{d^2}$$

Where D equals diameter of plunger, d equals diameter of pipe. And when the speed of the plunger is known the velocity of the water in the discharge pipe may be determined by formula:

$$\frac{D^2 \times T}{d^2} = V.$$

Where D=diameter of plunger in inches,
T=travel in feet,
d=diameter of discharge pipe in inches,
V=velocity of discharge in feet per minute.

Example: The plungers of a pump are 10 inches in diameter and have a travel of 100 feet per minute. At what velocity will the water travel through a discharge pipe 2 inches in diameter?

$$\frac{D^2 T}{d^2} = \frac{10^2 \times 100}{2^2} = \frac{10000}{4} = 2500 \text{ feet per minute.}$$

The work done due to the energy of motion of a moving body is represented by the formula:

$$\frac{W V^2}{64}$$

Where W equals the weight, V equals velocity in feet per second.

Example: The piston of an hydraulic ram is 12 inches in diameter; water in feed pipe has a velocity of 2,000 feet per minute; feed pipe to ram is $\frac{3}{4}$ inch. What is the energy of ram per pound of water used?

Velocity in feet per second equals

$$\frac{2000}{60} = 33.33.$$

It has already been shown that the velocity of water in pipes depends upon the areas or diameters squared; consequently $12^2 \div .75^2 = 144 \div .5625 = 256$. That is, 256 is the ratio of velocity of water in feed pipe as compared with the velocity of the water in the ram. Therefore, if the water in the ram moves at the rate of 1 foot per second, the water in the feed pipe must move at the rate of 256 feet per second, and the amount of work done is the same in each case. The difference in areas causes the ram to move only $\frac{1}{256}$ the speed of the pump, and what the ram loses in speed it must gain in force, since energy is indestructible, and the pressure exerted by the ram must be 256 times greater than that in the pipe to make up for loss in speed.

Energy of motion in pipe then equals

$$\frac{W V^2}{64} = \frac{1 \times 33.33^2}{64} = 17.35 \text{ ft. lbs.}$$

Then the work done by ram per pound of water used equals 17.35 + 256 = 441 - 60 foot pds. per pound of water used.

The pressure due to velocity is found by dividing the square of the velocity in feet per second by the constant 148.3.

Example: The piston of an hydraulic ram is 6 inches in diameter; velocity of water in a $\frac{1}{2}$ -inch feed pipe equals 2,500 feet per minute. What is the work done by the ram per pound of water used, and what is the pressure per square inch due to velocity, and if the energy of the water had been turned into heat what would be the rise in the temperature of the water?

Velocity of water in feed pipe per second equals

$$\frac{2500}{60} = 41.33,$$

and $6^2 \times .5^2 = 36 \div .25 = 144$, ratio of velocity in ram as compared with feed pipe;

$$\frac{W V^2}{64} = \frac{1 \times 41.33^2}{64} = 26.69 \text{ foot lbs. energy of motion per pound of}$$

water in feed pipe; $26.69 \times 144 = 3843.36$ foot pounds per pound of water used by ram; $V^2 = 1708.16$, and pressure due to velocity in pipe equals

$$\frac{1708.16}{148.3} = 11.51 \text{ pounds per square inch.}$$

Then the pressure on the ram must equal $11.51 \times 144 = 1657.44$ pounds per square inch.

The mechanical value of a British Thermal Unit (B.T.U.) is equivalent to raising 1 pound 772 feet high in one minute, or what is the same thing, raising 772 pounds one foot high in the same period of time; therefore a raise of 1° F. in the temperature of a pound of water equals 772 foot pounds of energy.

$$\frac{26.69 \text{ energy per pound of water in feed pipe.}}{772}$$

equals .0345° F. increase of temperature of water in feed pipe. Then

$$\frac{3843.36}{772} = 4.98^\circ \text{ F. rise of temperature in ram.}$$

Then if the whole of the energy of the ram had been expended in heat it would have given off sufficient heat to have raised the temperature of each pound of water 4.98° Fahrenheit.

OILS OF THE ENGINE ROOM.*

(Continued.)

We will now take the three main groups—animal, vegetable and mineral—and discuss their constitution and their behavior under the conditions which we will meet with in their use as lubricators. Oils from the animal and vegetable kingdom are fat oils; those from the mineral kingdom are not. In the first group, animal oils, we will find that oils from fish fat predominate, and that oils from other animal sources include in the largest proportion oils from the hog, and the balance will be very indiscriminate, refuse from slaughter houses, fat recovered from soap making, etc. Vegetable oils will be found to be the product of nuts, or nut like fruits. This includes seeds. All seeds contain oil in greater or less quantities, the oil being part of the food stored in the seed for the nourishment of the young plant. Oils are also obtained from the whole plant, as in the case of oil of peppermint, or the leaves, as wintergreen, or the petals of the flower as rose, or the wood fibre as turpentine, or the bark as cinnamon and from roots, so that you will see the oil exists in all parts of plants, but that the main supply is from the fruit. Oils from the mineral kingdom are not fats, that is, they cannot be divided by alkalies. They do not produce glycerine when decomposed as in the case of fats.

We have now ascertained the sources of oils, and will now go into the constitution of them, as this will bring us to the application of the knowledge we have obtained to understanding the changes which take place in oil when used for lubrication.

Animal fats or oils will be the first group to be considered, and under this head we have:

Fish oils—Whale, cod, shark.
Hog products—Lard oil, fat oil.
Horses and Cattle—Candle fat, suet, tallow, olein oil.

Most fats are mixtures of two or more compounds: Stearin, palmitin, olein and cetlin. Fish and other animal oils consist of olein, palmitin and stearin, which compose the fluid portion, and cetlin, the solid portion. Olein is oleic acid, or oleate of glyceryl, and when olein or the fluid part of oil is acted on by hot steam, a separation of glycerine and oleic acid ensues. Olein when mixed with an alkali forms oleate of that alkali, and glycerine is again set free. We will notice by this table that olein is a constituent of nearly all fats—animal or vegetable.

Almond Oil.....	Olein	Palmitin
Olive Oil.....	Chiefly.	Very little.
Lard Oil.....	"	"
Castor Oil.....	Ricinolein.	Palmitin and stearin.
Cottonseed Oil.....	Olein.	Palmitin.

Palm oil is composed of palmitin and olein (it rapidly becomes rancid and acquires an acid reaction). Suet is almost exclusively stearin; tallow, stearin and olein.

We observe from this that oils or fats are composed of substances which decompose at a high temperature; hence, while they in many cases would be found of great service in cold bearings, only certain of them would be of use in hot bearings, and it is here that we find mineral oils to be of advantage, as they do not decompose. Cylinder oils ought more especially to be free from decomposable substances, from rancidity, and, in a word, to be of a lubricating nature under the influence of a high temperature in the presence of moisture. The evidence that these oils do fulfill these requirements is that the oils from the exhaust are used again after filtration, etc., showing that it has not been decomposed or destroyed, as would be the case were the oil not to possess sufficient stability.

* Paper read before Hamilton No. 2, C.A.S.E., by J. W. Williams, chemist for Winer & Co., wholesale druggists.

ELECTRIC RAILWAY DEPARTMENT.

DIRECT CONNECTED GENERATORS FOR RAILWAY WORK.

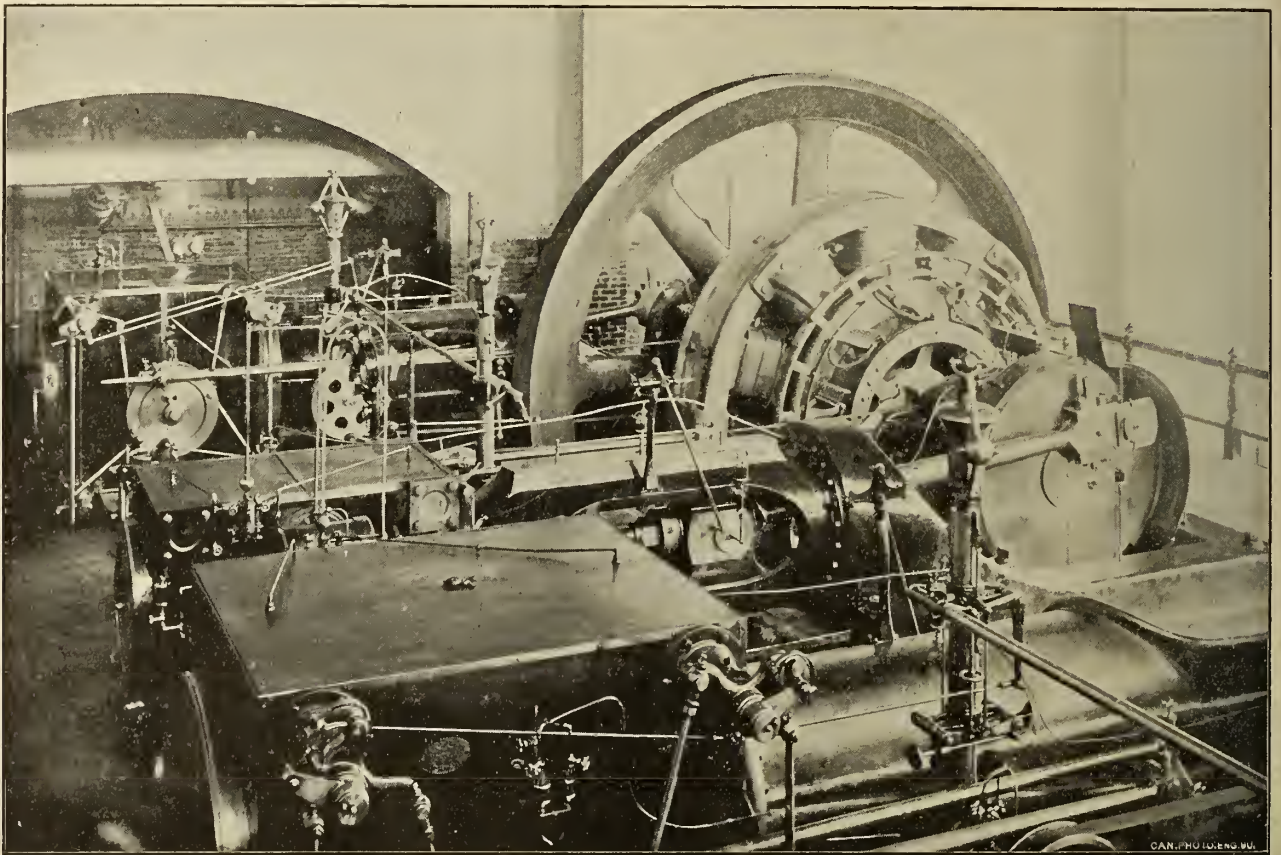
THREE years ago the Canadian General Electric Company installed in the power house of the Toronto Railway Company the first direct connected generator to be used for railway service in Canada, the machine being designed for larger outputs and slower speeds than the belted generators formerly used. It was claimed for this type of apparatus that it was capable of meeting the severest requirements of surface or elevated railway work, and possessed the additional advantage of greater reliability. In practice it must have been found satisfactory, as the Toronto Railway Company recently placed an order with the manufacturers for a duplicate of the machine, which has just been installed, and is herewith illustrated. A Siemens & Halske machine was replaced by this latter unit.

These generators are of 850 kilowatts capacity each,

sparkling; armature hub bolted direct to fly wheel on larger sizes, removing strain from shaft and keys; absence of all volts through laminations; armature laminations separated from each other by fire proof insulation, preventing loss from eddy currents and yet maintaining permanent solidity of construction; flexible leads from armature conductors to commutator. A special feature is the barrel winding, a modification of the drum winding, having all the conductors held symmetrically on the cylindrical periphery of the armature. The end flanges extended laterally like a pulley, form a support for the end connections, the conductors being firmly secured in the armature slots and on the end flanges by metal bands, so that vibration is rendered almost impossible.

SPARKS.

Mr. Wickstead, engineer, has submitted to the town council of Cobourg, Ont., a scheme to develop the water power of Balti-



850 k.w. DIRECT-CONNECTED GENERATOR INSTALLED FOR THE TORONTO RAILWAY COMPANY.

having ten poles, and operate at 90 revolutions per minute. They have steel frames, the combined weight of which, with pole pieces, is about 80 tons. The armatures are of the iron-clad type and weigh about 25 tons each. The machines are regulated for a regular running load of 1,500 amperes, but by practical operation have been proven to be of much greater capacity. They are of the same type as the 1,500 k.w. generator which has since been installed for the Montreal street railway, the 400 k.w. for the Winnipeg railway, and the two 500 k.w. at Quebec.

The manufacturers claim for them many advantages, among which are the following: Removable pole pieces, facilitating repair of field spools and permitting their removal without disturbing field frame or armature; frames adjustable in every direction; compounding proportional to current, so that machines will operate perfectly in parallel with each other; cool fields and permanency of insulation; commutator separated from armature, giving advantage of deeper segments and securing successful operation of carbon brushes; great number of segments in commutator, reducing volts per bar to a safe minimum and insuring freedom from

more creek. The cost of furnishing 400 horse power is estimated at \$55,000.

The death is announced of Mr. James Geen, electrical contractor, of Montreal.

The electric light company at Milltown, N. B., recently added a new engine to their plant.

The Bell Telephone Co. are having plans prepared for a new exchange to be built on St. John street, Quebec.

The Hamilton Radial Railway Company is said to have abandoned the idea of extending its road beyond Burlington.

The Winnipeg and Fort Alexander Railway Company is asking for power to build railways, telegraph and telephone lines.

The Toronto Railway Company have just placed an order with the Canadian General Electric Company for 20 G. E. 1000 motors, with K-10 controllers.

Mr. T. H. McCauley, electrical expert for the Royal Electric Co., Montreal, recently installed the new plant for lighting the town of Fort William, Ont.

The British Columbia Railways Company have placed an order for a freight car, using "Brill" trucks and G. E. 1200 motors, with the Canadian General Electric Company.

The Canadian General Electric Company will supply the entire electrical equipment for the new St. Thomas street railway. The order covers two 100 kilowatt generators and eight two motor equipments. The contract for cars was given to the Ottawa Car Company, and for the steam engine to the Robb Engineering Company, of Amherst, N. S.

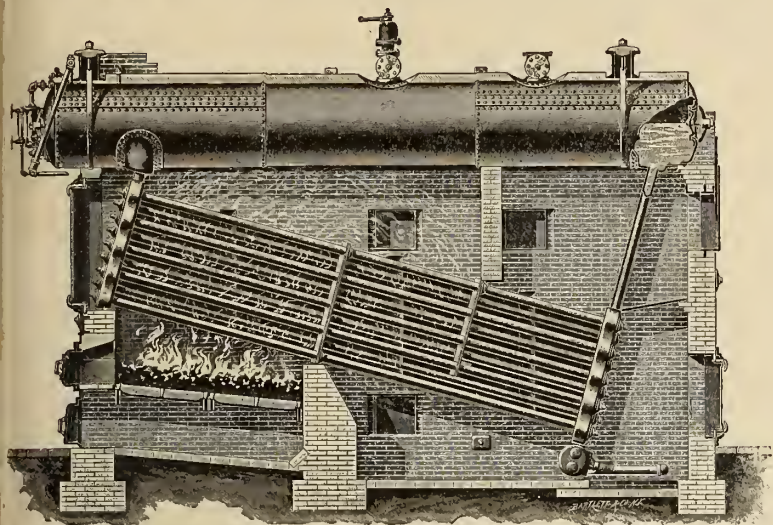
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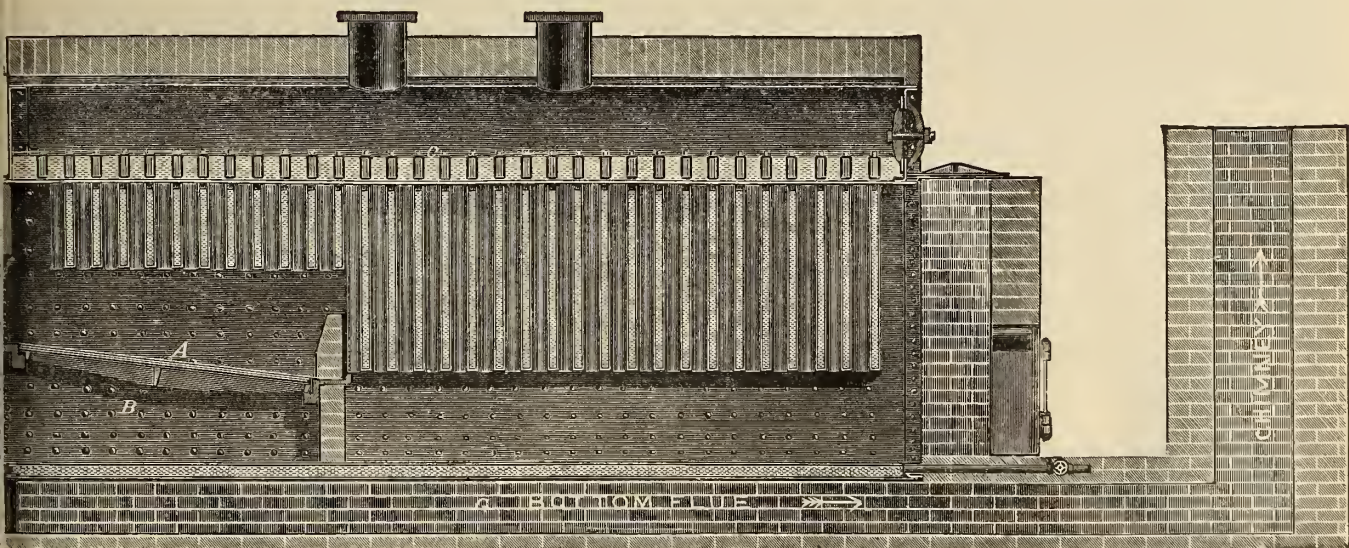


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SPARKS.

The Puget Sound Telegraph Co. are now extending their line to Victoria, B.C.

The annual meeting of the Winnipeg Electric Street Railway Company will be held in Winnipeg on the 8th instant.

The village of Tilbury, Ont., has concluded an arrangement with Mr. R. H. Smith to continue the electric light system.

Mr. C. W. Richardson, of Morpeth, is advocating the construction of an electric railway from Chatham to Rondeau Park.

Mr. James Fowler, of Arnprior, is endeavoring to revive the proposal to construct an electric railway from Perth to Lanark.

James Steele, of Guelph, Ont., has patented a street car fender, which is now being tested by the Toronto Street Railway Company.

C. Fraser has succeeded Mr. Brown as electrician at the Stoney Creek power house of the Hamilton, Grimsby and Beamsville railway.

Mr. T. H. Smallman and others, of London, Ont., are asking permission to build a steam or electric railway from that city to a point near Grand Bend, on Lake Huron.

It is understood that the Ottawa Electric Railway Co. will undertake the construction of a bridge 1345 feet in length over the Ottawa river between Hull and Ottawa.

Mr. J. M. Green and the St. Thomas Gas Co. have tendered for the supply of power for the operation of the St. Thomas street railway. It is likely that Mr. Green's tender will be accepted.

The Ottawa Car Company are announced to have received an order from the Hull Electric Railway Co. for five open cars, one motor and four trailers. They will also remodel the parlor car of the company, putting in longitudinal seats.

Russell county residents are advocating the construction of an electric railway between Ottawa and Metcalfe, a distance of about twenty miles. One drawback to the carrying out of the scheme is said to be the lack of a suitable water power.

The promoters of the St. Thomas street railway have let the contracts for construction, and hope to have the road in operation early in the summer. At a meeting held on the 2nd instant, the company authorized the issue of debentures for the sum of \$50,000.

The Saugeen Electric Light and Power Co. of Ontario has been incorporated, with a capital of \$20,000. The members are: Chas. E. Kilmer, of Southampton; C. H. Burham, of Port Elgin; Ed. Kilmer, of Walkerton; Jos. Barber and James Barber, of Georgetown.

Prefontaine, St. Jean, Archer & Decary, of Montreal, are acting as solicitors for the North Shore Electric Railway Co., which purposes constructing an electric railway on the north shore of the St. Lawrence river. This is the company formed by Mr. A. J. Corriveau.

The British American Light & Power Co. have an application before the Dominion Parliament for power to construct and operate, by electricity or other motive power, tramways in Dawson city, Fort Selkirk, and other points in the Yukon district and Northern British Columbia.

At the next session of the Manitoba legislature a company, composed largely of Winnipeg capitalists, will ask for a charter to build an electric railway from Winnipeg to St. Andrew's rapids, and through the municipalities of Springfield, St. Boniface, Kildonan, St. Paul's and St. Andrews. The company also propose to construct telegraph and telephone lines.

The Montreal Belt Line Railway Co. has given notice of an application to parliament to change the name of the company, and to extend the time for the commencement and completion of its branches. A rumor is current that the amalgamation of the Montreal Street Railway Co. and the Montreal Park and Island Railway Co. will be effected at an early date.

The Montreal Street Railway Co. have issued an order that motormen and conductors must purchase new uniforms once a year. Some of the employees regard the regulation as a hardship, but Mr. McDonald, superintendent, states that the company are determined to have their employees neat in appearance, and that one-third of the cost of the uniforms is borne by the railway company.

The Halifax & Bedford Electric Railway Co. is applying to the Nova Scotia legislature for incorporation, the object being to build an electric railway from Halifax to Bedford, with such ex-

tensions as may be approved of by the municipalities. The promoters are: Dr. Chisholm, W. E. Crowe, Ex-Mayor Keefe, Robt. O'Mullin, Arthur S. Soulis and E. T. Freeman, of Halifax, in which city the head office is to be located. The capital stock is placed at \$250,000.

The Premier of Newfoundland has moved in the legislature a resolution favoring the transfer of the colony's railway system, telegraph lines and coal areas to Mr. W. J. Reid, the well-known contractor of Montreal. One of the chief features of the proposed arrangement is the extension of the telegraph system along the west coast of the straits of Belle Isle, and thence north along Labrador. It is possible that the Dominion government will be asked to subsidize the service.

The Dominion government will probably be asked to make an appropriation at this session for the extension of the government telegraph system to the Yukon country. At the present time the government telegraph line extends from Ashcroft, B.C., to Quesnelle, a distance of 225 miles. From this latter point to Telegraph Creek is 540 miles. The proposal is to build the section to Teslin Lake next season, reaching the Yukon in 1899. The cost is roughly estimated at half a million dollars.

The annual meeting of the Guelph Light and Power Company was held in the city of Guelph on February 14th. The statements presented were found satisfactory, and the board of directors re-elected as follows: D. Guthrie, president; Richard Mitchell, vice-president; G. A. Oxnard, Thos. Gowdy, James Innes, Dr. Foster and Geo. D. Forbes. A vote of thanks was passed to the directors, in acknowledging which the president referred to the efficient services of the manager, Mr. John Yule.

The Sydney Electric Light & Gas Co., of Sydney, C.B., are making extensive alterations and additions to their plant, and have placed an order with the Royal Electric Co. for one 60 k.w. and one 40 k.w. S.K.C. two-phase alternators. These machines are connected to deliver 150 volts per phase. This is the fourth order that has been placed with the Royal Electric Co. for low tension generators of this type within the last few months, and is an evidence of the growing popularity of these machines for this work.

MOONLIGHT SCHEDULE FOR APRIL.

Day of Month.	Light.	Extinguish.	No. of Hours.
	H.M.	H.M.	H.M.
1....	A.M. 1.50	A.M. 4.50	3.00
2....	" 2.20	" 4.50	2.30
3....	No Light.	No Light.	.....
4....	No Light.	No Light.	.....
5....	No Light.	No Light.	.....
6....	No Light.	No Light.	.....
7....	P.M. 6.50	P.M. 9.30	2.40
8....	" 6.50	" 10.00	3.10
9....	" 6.50	" 11.20	4.30
10....	" 6.50	A.M. 12.30	5.40
11....	" 6.50	" 1.30	6.40
12....	" 6.50	" 2.20	7.30
13....	" 6.50	" 3.00	8.10
14....	" 6.50	" 3.30	8.40
15....	" 7.00	" 4.00	9.00
16....	" 7.00	" 4.30	9.30
17....	" 7.00	" 4.30	9.30
18....	" 7.20	" 4.30	9.10
19....	" 7.20	" 4.30	9.10
20....	" 7.20	" 4.30	9.10
21....	" 7.20	" 4.20	9.00
22....	" 7.50	" 4.20	8.30
23....	" 8.50	" 4.20	7.30
24....	" 9.50	" 4.20	6.30
25....	" 10.30	" 4.10	5.40
26....	" 11.00	" 4.10	5.10
27....	" 11.20	" 4.10	4.50
28....	" 11.50	" 4.10	4.20
29....		" 4.10	3.50
30....	A.M. 12.20		

Total..... 163.20



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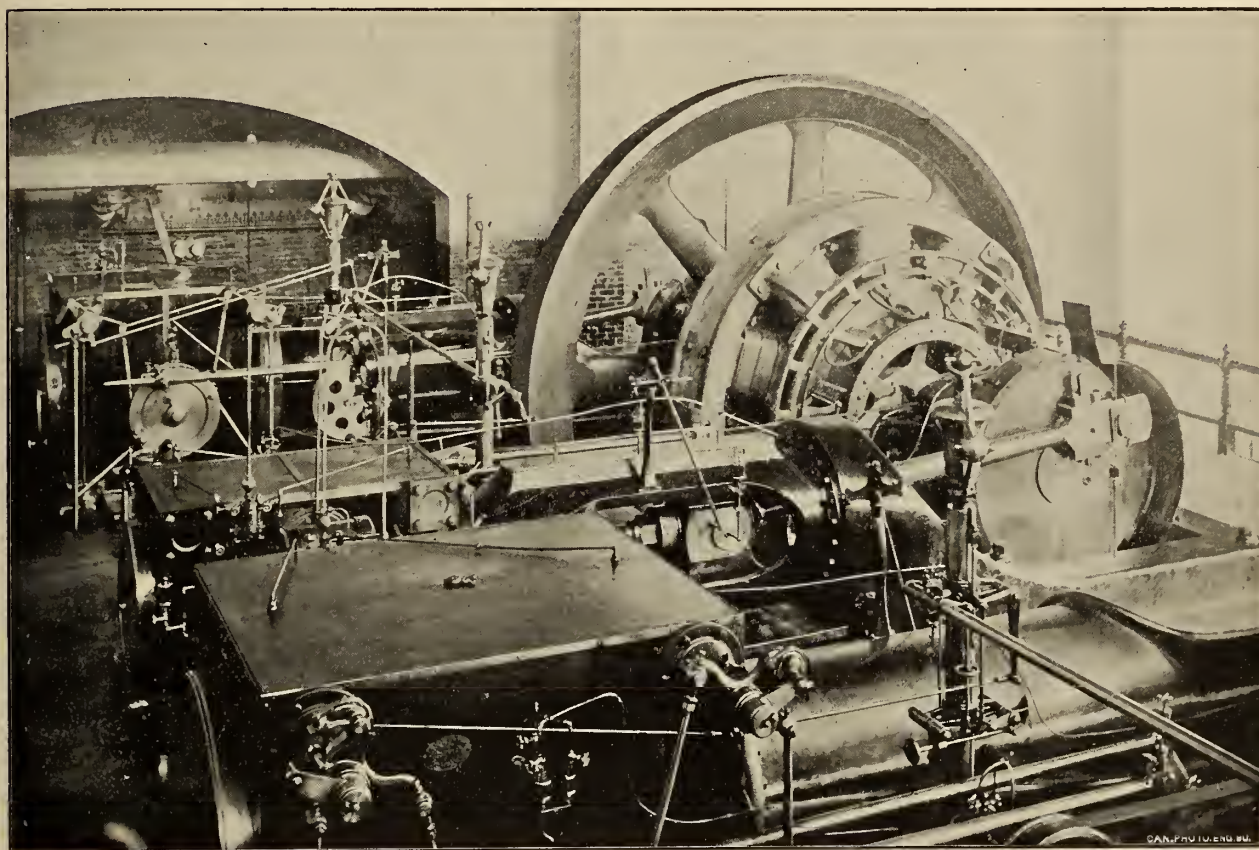
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SPARKS.

The Guelph Light & Power Company recently started up their new Brush arc machine.

D. Knechtel & Son are putting in a new 130 horse power water wheel at their works at Maple Hill.

Mr. G. A. Paterson, manager of the Brandon, Man., Electric Light Co., was a recent visitor to Toronto.

A by-law providing for the installation of an electric light plant has been carried by the ratepayers of Beeton, Ont.

J. L. McKenzie & Co., manufacturers of electrical apparatus, Victoria, B.C., have been succeeded by Wm. Watson.

S. Lennard & Sons, of Dundas, placed an order some time ago with the Canadian General Electric Company for a 100-light incandescent plant.

Messrs. Edgar & Roy, of North Hatley, Que., have purchased from the Royal Electric Co. a 60 k.w. S.K.C. two-phase generator.

The Sherbrooke Street Railway Company have recently placed an order with the Canadian General Electric Company for additional G. E. 1000 equipments.

The North Shore Power Company are said to be negotiating for the operation of the waterworks system of Three Rivers, Que., by electricity.

The electric light plant owned by the village of Markham, Ont., was destroyed by fire a fortnight ago. Steps were taken immediately to rebuild.

The annual meeting of the Hamilton Electric Light and Power Company was held in Hamilton last month, at which all the officers were re-elected.

The Midland Electric Light Co., of Midland, recently placed an increase order with the Canadian General Electric Co. for a 60 k.w. single-phase alternator of the company's standard type.

The Manitoba District Telegraph Co. is seeking incorporation, the applicants being John Galt, Wm. Hespeler, R. J. Campbell, Frank A. Drummond and F. W. Heubach.

Incorporation has been granted to the Cardinal Electric Light Co., Limited, with a capital stock of \$20,000. Geo. F. Benson, of Montreal, John D. Reid, of Cardinal, and others, are interested.

The Metropolitan Street Railway Company have purchased G. E. 1000 equipments from the Canadian General Electric Company. These will replace the motors burned in the fire recently at their car barn.

The Electric Light Company of Edmonton, N.W.T., has purchased a new plant complete, including a 75 k.w. S.K.C. two-phase generator, with Stanley transformers, from the Royal Electric Co.

The Chateauguay & Northern Railway Co., of Montreal, have placed an order with the Canadian General Electric Company for a 325 kilowatt steel frame generator. This will give them a total capacity of 525 kilowatts.

The Hull Electric Company have ordered thirty-six G. E. 1000 motors from the Canadian General Electric Company. These will be used as four-motor equipments, making in all fifty-two motors of this type which the Hull electric road will have in operation.

Arrangements are being completed to light the village of Harrow, Ont., by electricity. Mr. Goodchild, of Colchester South, will operate the plant.

The Sauble Falls Ranch & Lumber Co., which has recently been incorporated, has been given power to construct at Sauble Falls, Ont., works for the distribution of electricity for light, heat and power.

The Canadian General Electric Company have been awarded the contract for supplying electrical machinery for lighting and power purposes at Ashcroft, B. C. The three-phase system will be used, and the pumping for the town waterworks will be done by an induction motor.

The town council of Orillia, Ont., have engaged Mr. Wm. Kennedy, hydraulic engineer, of Montreal, to report on the probable cost of the hydraulic work in connection with the development of the water power of Ragged Rapids.

The Canadian General Electric Company have closed a contract with the Montreal Transportation Company, at Kingston, Ont., for a 25 k.w. generator of their direct connected type. This machine will be used for lighting the new elevators and other buildings of the company at Kingston.

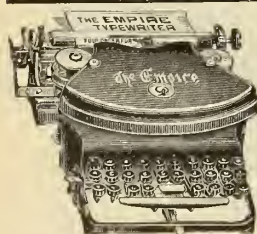
The C.P.R. Telegraph Co. are announced to have decided to string a heavy copper wire from Montreal to the Pacific coast. It is stated that a second cable will also be laid from Vancouver to Victoria, B.C., a distance of 45 miles.

The Canadian General Electric Company are supplying three small direct connected units for the C. P. R. steamships on the Stickeen river. These machines will be 4 kilowatts each, direct connected to vertical engine of special type, running at 600 revolutions per minute.

The Deschenes Electric Co., Limited, have elected directors as follows: Alex. Fraser, president; W. J. Conroy, vice-president; David Maclaren and Robt. Anderson. The head office of the company has been established at 158 Canal street, Ottawa.

The Electric Reduction Company, of Buckingham, Que., have placed an order with the Canadian General Electric Company for a 1,000 h.p. three-phase revolving field generator, to be used for electrolytic work. The machine will be similar to those installed at Lachine and West Kootenay, except that the current will be supplied at the low potential of 75 volts.

The annual meeting of the Bell Telephone Company was held in Montreal last month. Directors were elected as follows: C. F. Sise, Robt. Mackay, John E. Hudson, Robert Archer, Wm. R. Driver, Hugh Paton, Charles Cassils, Thos. Sherwin. The eighteenth annual report, in part, said: During the year 983 subscribers have been added, the total number of sets of instruments now earning rental being 30,445. The company now owns and operates 349 exchanges and 261 agencies. Thirty-five miles of poles and 703 miles of wire have been added to the long distance system in 1897; the long distance lines now owned and operated by the company comprise 15,567 miles of wire on 6,095 miles of poles. The directors have charged to contingent fund \$150,000, that amount having been expended during the year on construction rendered necessary by the introduction of trolley and other strong current wires, but which has not increased the earning power of the plant. The receipts for the year were \$1,185,685.21 and the expenses \$906,933.64, leaving a net revenue of \$279,751.57.



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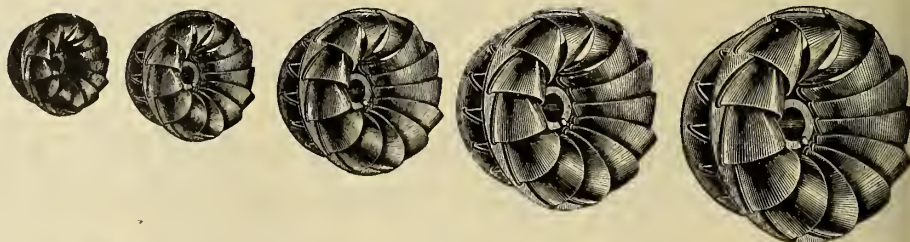
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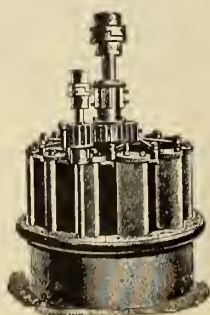
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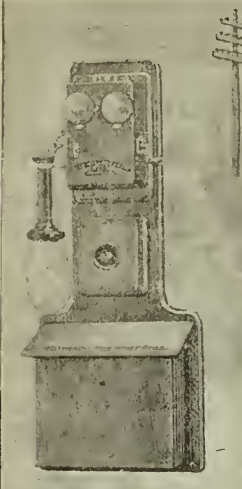
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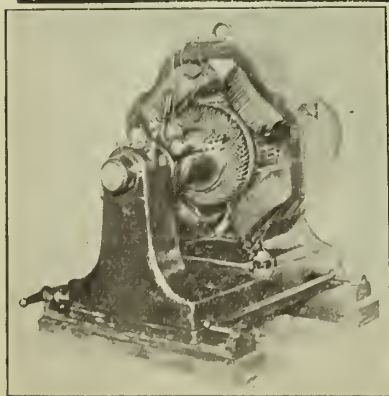
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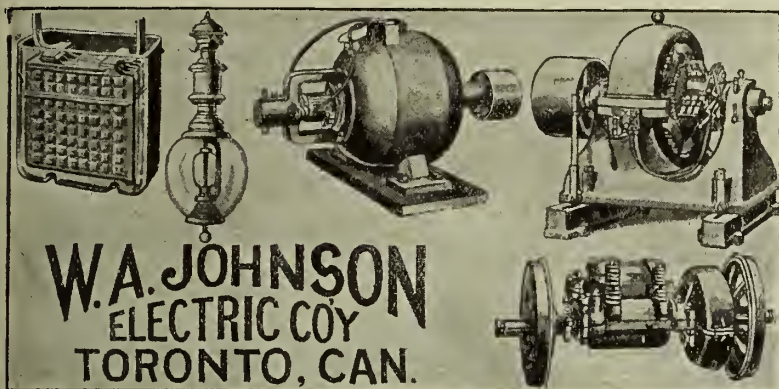
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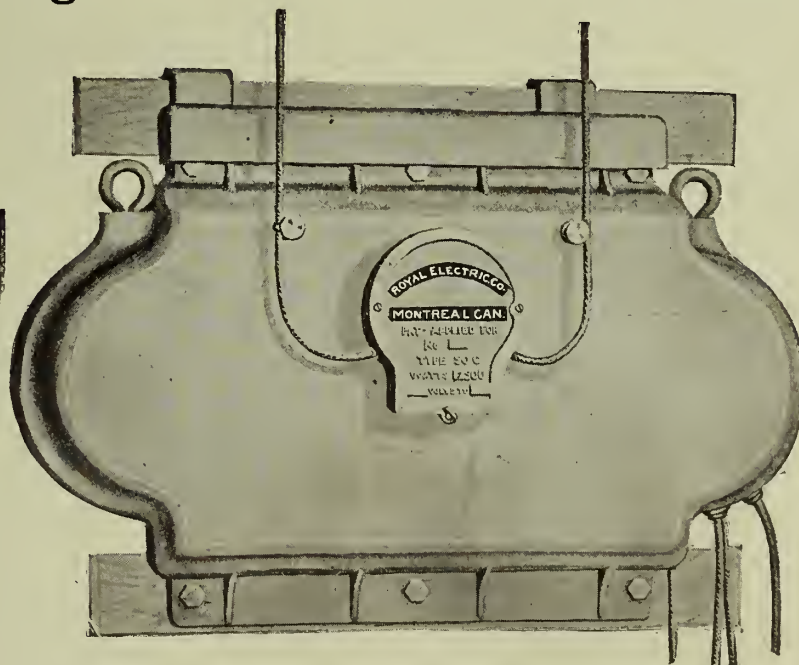
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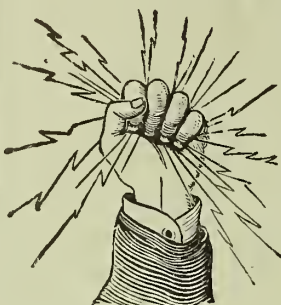
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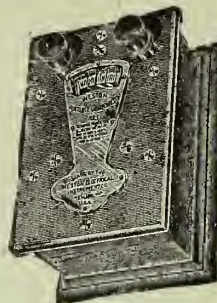


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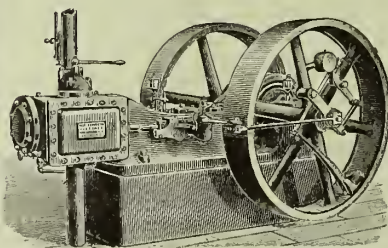


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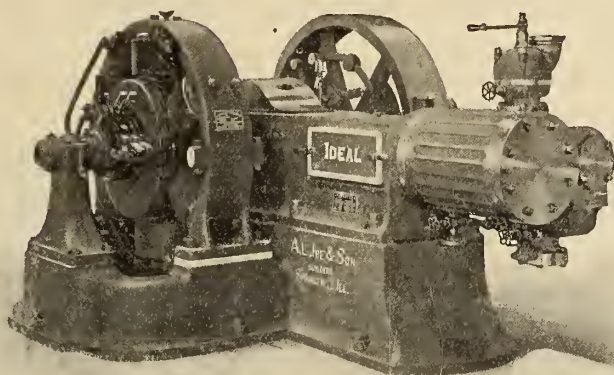
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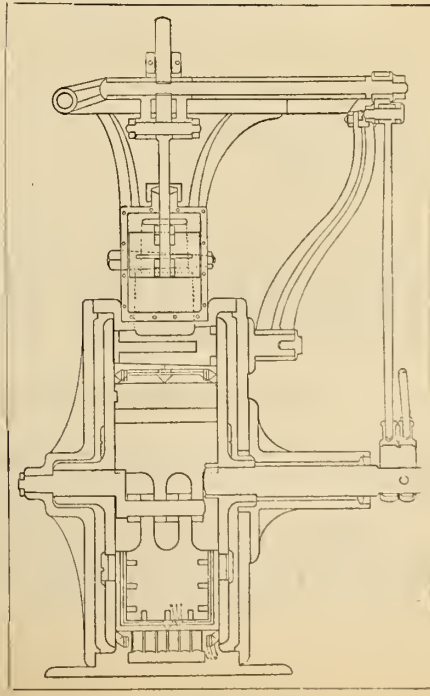
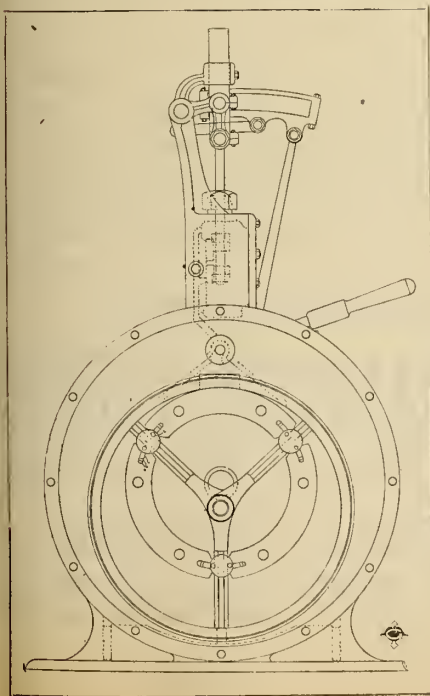
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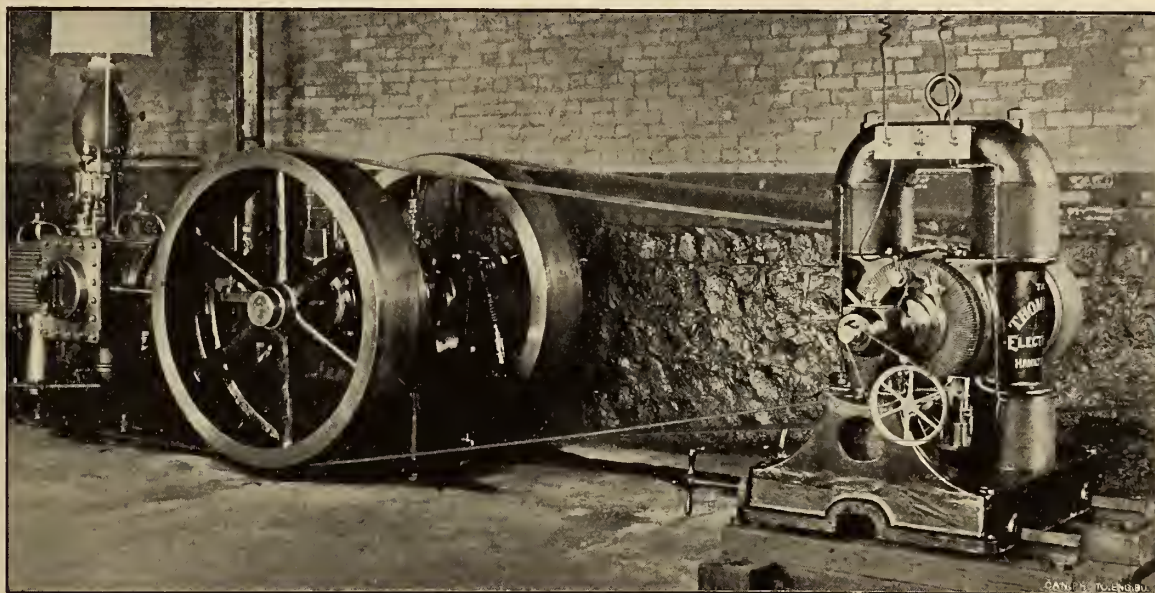
CHATHAM MUNICIPAL LIGHTING PLANT.

THE year 1897 marked the inauguration of the electric light plant installed, under civic control, for lighting the streets of the city of Chatham, Ont. In February of that year a by-law was carried by the ratepayers authorizing the City Council to expend \$15,000 in the purchase of an arc plant. Tenders were subsequently invited and awards made for the same. The contract for the complete electrical equipment, including dynamos, lamps, wiring, etc., was placed in the hands of the Thompson Electric Company, then of Hamilton, but now amalgamated with the Toronto Electric Motor Co., and doing business in Toronto. Messrs. E. Leonard & Sons, of London, were the successful tenderers for the

arrester. Wherever possible the circuit is divided into loops, comprising some 5 to ten lamps, each loop being controlled from a substantial absolute cut-off switch. The interior wiring is of No. 6 B. & S. rubber covered wire.

A plug switchboard, arranged so that machines and circuits may be interconnected, is provided. This is furnished with ammeters and magnetic blow-out lightning arresters of a new pattern, the whole being neatly arranged on a white marble base.

The plant is said to have been subjected to the most vigorous tests, and to have proved very satisfactory. The machines were short circuited at full load for one minute, and also while at full load the circuits were



VIEW OF ELECTRIC LIGHT PLANT, CHATHAM, ONT., SHOWING ONE ARC MACHINE AND ENGINE.

engine, and Park Bros., of Chatham, for boilers. The accompanying view shows one of the arc machines and the engine.

The electrical equipment consists of two automatic arc dynamos of nominally 50 lamps capacity each. These are supplying current to 104 arc lamps and 10 series incandescents through circuits which aggregate some 24 miles in length. The 10 incandescent lamps and 2 arc lamps are used for illuminating the power house and adjoining waterworks plant, while 102 lamps are for street illumination exclusively. These latter are provided with substantial telescoping storm protectors, and are suspended from a suitable steel mast arm. Sleet proof lamp-supporting pulleys and thoroughly insulated lamp hangers are used throughout.

The outside circuit throughout is of No. 6 B. & S. hard drawn copper wire, triple braided, strung over double petticoat insulators, and at intervals of two miles is protected by an effective magnetic blow-out lightning

suddenly opened. These tests thoroughly demonstrated their ability to withstand any exigencies of service.

The engine is a Leonard-Ball automatic compound, of 100 h.p., and is designed with a heavy shrouded frame and box base. The bearings are large and well-proportioned. The engine is well finished and is equipped with a very complete oiling device, making a power plant neat in appearance, silent running and economical.

The Windsor Hotel Company, Montreal, Que., are making extensive alterations in their electric installation, and have ordered from the Canadian General Electric Company two 1,000 light slow speed multipolar generators, with marble switch-board panels.

Mr. Wm. Fowden, of Camden, N. J., gives the following plan for preventing arc lamps from freezing: Take a number of thin sheets of cardboard and punch a hole in them the same size as the carbon, and if the trimmer thinks that things are going to freeze, slip one of these small pieces of cardboard on the upper carbon of the early side of the lamp. This will act as a shed for the water, and prevent the lamp from freezing.

THE DIESEL HEAT MOTOR.

An invention which is attracting considerable attention throughout the United States and Europe is the Diesel heat motor, the tests of which have shown remarkable results in the way of converting the whole heat contained in the fuel into actual work. In a paper read at a meeting of the Deutscher Ingenieure Verein, the inventor, R. Diesel, of Munich, describes the principles of the apparatus, from which we obtain the following particulars:

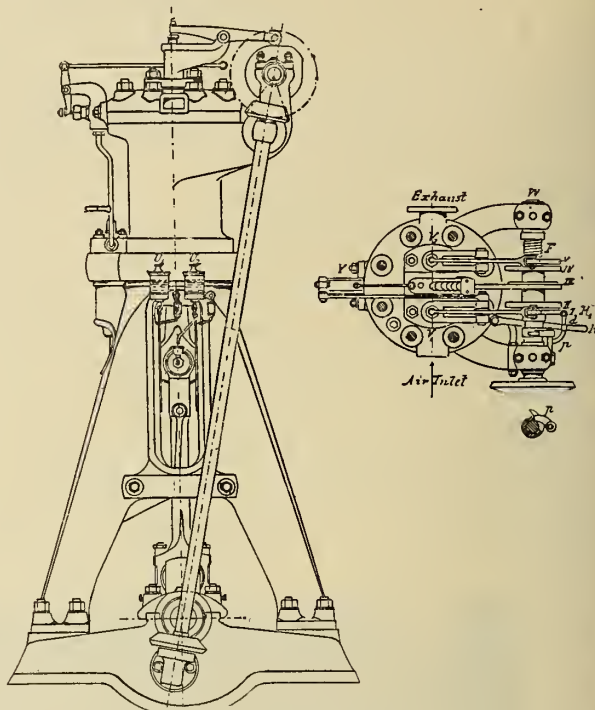
Mr. Diesel states that in every process of combustion two kinds of temperatures are to be distinguished: 1. The temperature of ignition; 2. The temperature of combustion. The temperature of ignition is that temperature to which a fuel must be heated to ignite it in presence of air. The temperature of combustion is that temperature subsequently generated by the chemical process of combustion after ignition has taken place. The combustion temperature must be generated not by the combustion and during the same, but before and independent of it after ignition has taken place, by mechanical compression of pure air. To deviate from the perfect process, directly compress the air adiabatically instead of first isothermally from 2 to 4 atmospheres and then adiabatically to the 30 or 40 fold. By so doing one realizes the first of the required conditions, i.e., the generation of the combustion temperature by mere compression with pressures which are two and four times lower than those used in performing the perfect cycle.

The fuel must be introduced gradually into the air, which is compressed adiabatically to the combustion temperature in such a manner that the heat generated by gradual combustion is absorbed in the so-called nascent state, in consequence of a corresponding expansion, i.e., by mechanically cooling off the gases so that the

fore always effected the increase in temperature by the combustion and during the same.

The fourth condition also presents a revolution of ideas hitherto considered correct, according to which the combustion had to be carried on with as little surplus of air as possible, while he contends that a considerable surplus of air, whose amount can be determined theoretically in each special case, is necessary.

The operation of the motor may be briefly described

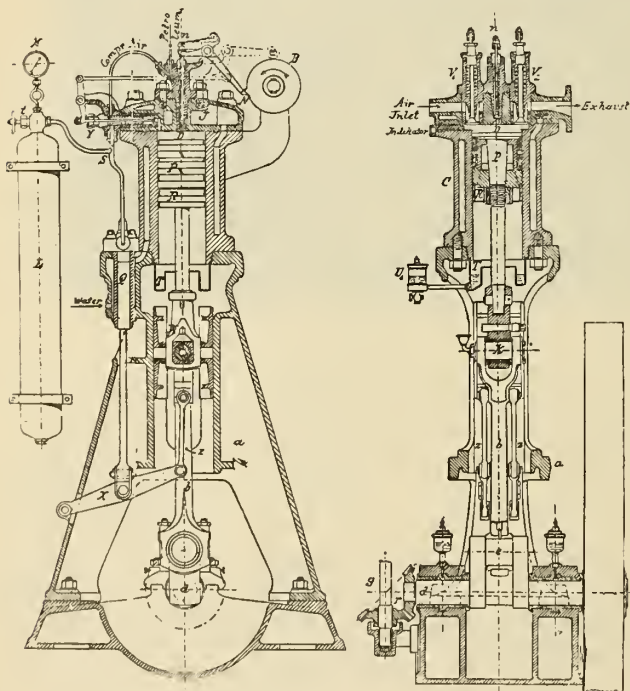


FIGS. 3 AND 4.—SIDE VIEW AND PLAN OF VALVES, DIESEL RATIONAL HEAT MOTOR.

as follows: An auxiliary air pump compresses the air to about 500 pounds per square inch, storing it in a separate reservoir, from which it is led into the cylinder along with the oil or gas or coal-dust, and compressed still further, the temperature due to compression rising to the ignition temperature of the combustible. The fuel begins to burn and generates still higher temperature and pressure by doing so; at the end of the stroke the consumed gases, still at a high temperature, are led into a larger low pressure cylinder, which brings the pressure down so low that the succeeding exhaust is comparatively quiet.

In such an engine there are great possible advantages of superiority over the steam engine. No steam boiler is used; there is, therefore, no loss of heat in the flue gases or by boiler radiation, nor steam pipe condensation. The maximum available theoretical efficiency for such a motor is greater than that of the steam engine, owing to the possibility of using higher pressures, and consequently a higher range of temperature. This theoretical efficiency varies from 50 to 70 per cent. There is no cylinder condensation, and several other sources of loss are abolished. The mechanical efficiency is, however, likely to be a little lower than that of the steam engine, owing to the high compression necessary and consequent transmission and retransmission of energy between the piston and the fly-wheel.

The experimental engines so far constructed have been of the single-cylinder four-cycle single-acting vertical type, one of which of 20 horse power was tested with petroleum in the early part of 1897. This engine is provided with a ring piston and separate cross head, water jacketed and provided with poppet valves operated by cams for admission and exhaust. A small pump is



FIGS. 1 AND 2.—CROSS SECTIONS OF DIESEL RATIONAL HEAT MOTOR.

period of combustion is going on constantly isothermally. It is evident that the fuel, in order to fulfil that condition, must be charged in its physical composition to a gaseous, liquid or powdery form. That is to say, that through the combustion and during the same, no, or a relatively small, increase of temperature is caused, an idea which seems to be absurd after having hereto-

attached which keeps an auxiliary vessel filled with air compressed to a higher pressure than that obtained in the cylinder. This serves to inject the fuel, and also to start the engine.

With this engine of 20 horse power working with refined liquid petroleum, the maximum available theoretical efficiency was about 50 per cent., and the actual ratio of indicated energy to the total energy of the fuel was about 35 to 40 per cent., showing an indicated efficiency of the engine as such of 70 to 80 per cent. The mechanical losses of this engine varied between 25 and 30 per cent. on high loads, giving over 26 per cent. of the total heat of the fuel as available energy at the shaft. With reduced loads the mechanical efficiency, of course, falls off, but the thermal efficiency, owing to the greater expansion, increases, thereby counterbalancing to a large extent the other and rendering the consumption of fuel per horse power low at all but the lightest loads. Owing to the high pressure employed in this engine also, the cylinder dimensions are from 30 to 50 per cent. less than those of gas engines of the explosion type.

The governing of the speed is also as simple and easy as that of the steam engine. The exhaust gases are noticeably invisible and nearly odorless during ordinary running, owing to the perfect combustion, which also prevents fouling of the interior of the engine.

In a paper read before the same meeting by Professor Schroter, describing the tests made with the engine, the following facts were shown :

There was a noticeably exact regulation of the combustion process. One hundred and more diagrams were found to coincide exactly as with steam engines on constant load. The ratio of indicated work on compression to that of indicated work on expansion, average values for full and half load being taken, showed a value of about 50 per cent. The mean effective pressure in the working cylinder was about $7\frac{1}{2}$ kilograms per square centimetre on full load and $5\frac{1}{4}$ on half load, corresponding to 100 and 70 pounds per square inch. The effective work was measured by a modified prony break. The mechanical efficiency, that is, the ratio of effective work to indicated work, varied from 75 per cent. to about 58 per cent., as the work was varied from full to half load. The consumption of petroleum per brake horse power was about 0.24 kilogram on full load and 0.28 on half load. Careful tests were made of the calorific value of this fuel, showing that there was converted into brake horse power over 25 per cent. of the available energy of the fuel at full load and over 22 per cent. at half load.

The Diesel motor has been patented in all countries where patents are granted for inventions, and the rights for the United States and Canada have been acquired by a company since incorporated under the laws of New York State as the "Diesel Motor Company of America," with offices at No. 11 Broadway, New York.

AMALGAMATION OF ELECTRICAL INTERESTS.

WITHIN the past month the amalgamation of the Thompson Electric Co., of Hamilton, and the Toronto Electric Motor Co., of Toronto, has taken place. The new concern will be known as the Toronto Electric Motor Co., Limited, with headquarters in Toronto, and a capital of \$50,000. A new factory building, 95 by 50 feet, is now being erected on Pearl street, which will be

equipped with modern tools for manufacturing and appliances for fully testing the finished product. A travelling crane will extend the whole length of the shop, and each machine will be connected with a separate motor, making a thoroughly complete establishment. The manufacture of arc and incandescent lighting and power plants will be continued.

CANADIAN ELECTRICAL ASSOCIATION.

A WELL attended meeting of the Executive Committee of the above association was held at the office of the secretary, Mr. C. H. Mortimer, Confederation Life Building, Toronto, on the 5th inst., to further arrangements for the annual convention which is to be held in Montreal.

The dates chosen for the convention are Tuesday, Wednesday and Thursday, the 28th, 29th and 30th of June. The headquarters of the association during the convention will be at the Windsor Hotel, where the business sessions and the annual banquet will also be held.

The draft programme recommended by the local committee of arrangements, with some slight amendments, was adopted, and is as follows :

FIRST DAY.—Executive meeting 9.30 to 10 a.m.; session, 10 a.m. to 1 p.m.; session, 2 to 5 p.m.; 7.30 p.m., trip around Mount Royal by special Park and Island cars, afterwards ascending Incline railway to lookout on mountain to view the city under illumination.

SECOND DAY.—Session, 9 to 12, noon; cabs and busses from Windsor Hotel at 1 p.m. to visit : (1) Bell Telephone Company's new building; (2) Street Railway Company's power house; (3) power house and works of the Lachine Rapids Hydraulic & Land Co., returning to city at 7.30 p.m.; 9 p.m., annual banquet of Association at Windsor Hotel.

THIRD DAY.—Session, 9 to 12 a.m., election of officers and visit to McGill University; 1.30 p.m., visit to Royal Electric Company's lighting station and factory, then by special G. T. train to visit the works of the Chambly Manufacturing Company at Chambly.

A number of very interesting and instructive papers relating to various phases of electrical work have been promised, and are in course of preparation.

Negotiations are in progress with the object of securing special transportation rates to enable a large number of the western members to participate in the proceedings of what will undoubtedly be a very pleasurable and instructive occasion. We hope to be in a position to announce further particulars in our May number.

PROPOSED MARITIME ELECTRICAL ASSOCIATION.

A MEETING has been called at the Halifax Hotel, Halifax, Nova Scotia, for Tuesday, the 12th inst., for the purpose of organizing a Maritime Electrical Association. The preliminary circular states that "while it is felt that all those engaged in the electrical business in Canada should, if possible, belong to the Canadian Electrical Association, there still remains a great need for an association of a more local character, whose place of meeting would be accessible to all its members, and which could discuss not only papers of a technical character, but also the questions arising from purely local circumstances." Among the principal promoters of the new organization are : Mr. E. T. Freeman, of the General Electric Co., Halifax; Mr. Jas. Waddell, P. E. I. Electric Co., Charlottetown, P. E. I.; Mr. F. A. Bowman, New Glasgow Electric Co., and Mr. J. H. Winfield, Nova Scotia Telephone Co., New Glasgow, N. S.

ROYAL ELECTRIC ENGINEERING SOCIETY.

AT a meeting of the Royal Electric Engineering Society held on March 17th, Mr. K. B. Thornton, of the Royal Electric Co., read a paper on "Alternating Current Arc Lamps," and at a meeting held on March 31st Mr. W. F. McLaren and Mr. R. F. Morkill read a paper on "Alternating Current Motors." Mr. Dix will read a paper at the next meeting on April 14th. The society are holding their meetings in the Board room at the Royal Electric Company's general offices, Queen street.

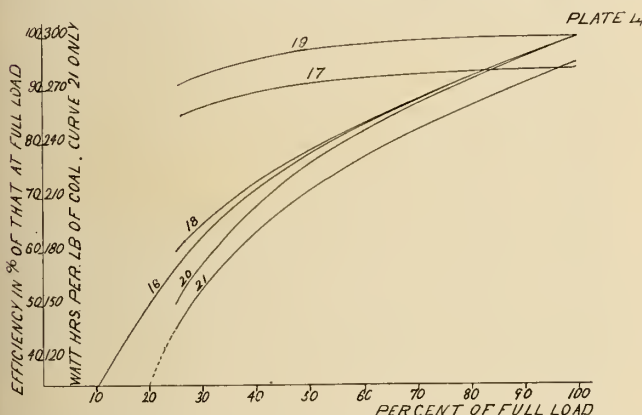
Messrs. Ness, McLaren & Bate, telephone manufacturers of Montreal, who were recently burnt out at No. 749 Craig street, have taken new premises at No. 419 St. James street (corner of Craig), and have put in a complete new plant of special tools and machinery for the rapid turning out of telephones, telegraph instruments and electrical supplies of all kinds, and they now have one of the best equipped and up-to-date factories in Canada.

peres at a pressure of 106 volts, or 318 K.W. supplied to customers. For an installation of this size in a city where the consumers do their own inside wiring and the line work is all above ground, the estimated cost of the construction work is placed at \$40,000. This provides for 6,000 60 watt lamps, and the estimation is made on figures obtained from one of the agents of the Canadian General Electric Company. The following items will have to be added to the cost account :

Interest on \$40,000 at 10%.....	\$4,000
Depreciation on construction work at 4%.....	1,600
Salary of clerk to keep books and render accounts, etc., at \$12 per week.....	624
Wages of boy to read meters, etc., at \$4 per week...	208
Total.....	\$6,432

This means that without taking into account the loss in distribution, 0.657 cents will have to be added to the cost per K.W. hour on the basis of 308 days of 10 hours, and 0.277 cents will have to be added in the case where the plant runs 365 days of 20 hours. Taking into account the loss in distribution, the total costs per K.W. hour as given in columns 35, 36, 37 and 38 are obtained.

Upon looking over the official reports of pumping engine tests, it is seen that the work actually done per pound of coal is in many cases equivalent to 400, 500, or even more watt hours, whereas in power houses the output is in many cases less than 100 and seldom over 200 watt hours per pound. This is notwithstanding the fact that an engine and dynamo can be constructed nearly, if not actually, as efficient as a pumping engine. The low efficiency is due directly and indirectly to the variable load, which has a still greater effect on the cost of production. It lowers the efficiency directly, as already pointed out in the preceding calculation. Moreover, if an attempt to keep up the efficiency is made



by dividing the units, it is still much lower than it would be with a constant load. The units must be smaller and, therefore, less efficient, and besides this there are extra belting and friction losses introduced. The total load line in most power houses will be made up of a number of different kinds of load lines. Curves 1, 2, 3, 4 and 5, on Plate I, are taken from a power house in a city having between thirty and forty thousand inhabitants, and illustrate what is meant. Different sizes and styles of units will have to be installed, and this results in a much lower efficiency than could be otherwise obtained. The engines used in the calculations represent good modern practice for this size and style, yet with these even at full load it can be seen that the efficiency is comparatively low, and with the load line assumed, which is equivalent to a load factor of 46, the efficiency has been reduced to 62.5% of that at full load.

The effect of the variable load upon the cost is even greater. The items which enter into the cost account may be classified as follows :

First : Those that vary directly as the output. The cost per unit is the same no matter what the load. This class includes such items as cost of carbons and incandescent lamp renewals.

Second : Those that decrease with the output, but not so rapidly. The cost per unit increases to a great or less extent. This class includes cost of coal, oil, supplies of certain kinds, and perhaps wages.

Third : Those that remain constant no matter what the output. The cost per unit varies inversely as the output. This includes insurance, taxes, rent, interest and generally wages.

It is evident, then, that as the two latter classes include the greater part of the costs, the cost per unit must greatly increase as the load factor becomes smaller.

MUNICIPAL OWNERSHIP VS. PRIVATE CORPORATIONS.

MR. M. J. Francisco, of Rutland, Vermont, has issued the fifth edition of his work entitled "Municipal Ownership vs. Private Corporations," in which he presents many strong arguments against municipal control of electric light plants. Mr. Francisco commenced the investigation of municipal ownership in 1885, and has personally visited nearly all the municipal plants in the United States and Europe. Having had many years' experience in the electric light business he is in a position to analyze statements made in regard to the management of plants, and to judge of their efficiency.

At the outset the author shows how many of the erroneous statements regarding the cost of electric light produced under civic control are arrived at, and refers at some length to municipal ownership in England and Scotland, where the actual facts prove it to be much less successful than is generally supposed.

Some figures submitted by Mr. Francisco are interesting. Statistics from 174 private companies show the cost per lamp per hour to be .0252 cents, while they furnish on an average 654 candle power per hour for one cent. The same analysis of 86 municipal lighting plants, taken from every state in the United States in which municipal plants are operated, shows that the average cost per hour is .0359 cents, while they only furnish on an average 404 candle power per hour for one cent. This shows that the private companies are furnishing the lights on contract on an average of .107 cents per hour less than the municipalities can produce them, and also furnishing 250 candle power per hour more for one cent than the municipal plants. Late reports from municipal plants also show that the expense of maintaining the plant is increasing each year, but notwithstanding this increased cost in municipal plants, the price charged by private companies for lights has decreased every year. A list is published of municipal plants that proved unsatisfactory, and were abandoned or sold.

Massachusetts, it is stated, has a commission which controls the electric companies, and from statistics obtained from the commissioners' report, the following figures as to the average cost are obtained :

Municipal Plants in Massachusetts.	Cost per year.	Cost per hour.	Candle power per hour for 1 cent.	Hours per night.	Nights per month.	Candle power of lamp.
Braintree.....	\$133 34	.0587	204	7	27	1,200
Dorchester.....	73 06	.05	240	6	24	1,200
Middleboro.....	107 34	.049	204	8	25	1,200
Marblehead.....	100 30	.036	333	8	29	1,200
Peabody.....	90 76	.0266	451	10	30	1,200
Reading.....	138 86	.0951	126	6	23	1,200
Wakefield.....	124 30	.0851	141	5	23	1,200
Average.....	\$110 99	.04	248	7	25	1,200
Private Corporations in Massachusetts.						
Hyde Park.....	\$ 66 66	.042	476	5	26	2,000
Chelsea.....	109 50	.0286	419	11	29	1,200
Boston.....	127 75	.0354	536	10	30	2,000
Springfield.....	75 00	.0208	576	10	30	1,200
Westfield.....	82 00	.0379	527	6	30	2,000
Haverhill.....	132 24	.038	526	10	30	2,000
Worcester.....	127 75	.0354	536	10	30	2,000
Average.....	\$102 98	.034	513	8	29	1,771

It will be seen that the average cost per lamp per year in the municipal plants is \$110.99, while the same cost with private companies is \$102.98. The average cost per hour is .04 and .034 cents respectively, and the average candle power per hour furnished for one cent 248 and 513.

LONG DISTANCE TELEPHONY IN CANADA.

RAPID as has been the development in the application of electricity to the requirements of social and commercial life, in no direction has this development been more surprising than in the science of telephony, and more especially in the extension of its capabilities for long distance communication. It is doubtful if the achievements of the long distance telephone are as yet fully appreciated by many who are well versed in the triumphs of other branches of electrical science; much less to the general public. It is our appreciation of this fact that induces the conclusion that a review of the long distance telephone service of the Bell Telephone Company of Canada would be interesting, as well as instructive, to many of our readers. Comparatively few people in Canada realize that to-day it is perfectly feasible to converse satisfactorily by long distance telephone, say, from Toronto to Portland; Montreal to Pittsburg or Chicago; Hamilton to Baltimore; or Ottawa to Washington. Yet it can be, and is being done.

Leaving aside altogether the enormous and constant application of inventive skill and capital which have been required to bring the local telephone service to its present efficiency, it is certain that the changes and the development of the long distance branch of the service have been equally radical and proportionately expensive.

The first attempt of the Bell Telephone Company of Canada to establish a long distance service, was made in 1881, by the construction of a single iron wire line between Toronto and Hamilton, then considered quite an achievement, and the line was well patronized. Within three years, 855 miles of poles and 1,500 miles of wire were constructed by the company, but so rapidly did conditions change, that even in this short time this type of line was found inadequate to the requirements of a growing business.

In 1885 copper wire was substituted for iron wire, affording better results. The introduction of the electric light and trolley, however, soon forced upon the company another and a more radical change, and metallic circuits had to be adopted upon all principal lines. This change, begun in 1885, was carried on as fast as circumstances would allow until all the principal lines of the company were made metallic, or, in other words, two wires were necessary to transmit a satisfactory conversation where one would suffice before the introduction of electric cars.

The extension of the system, in the meantime, went on apace, until, at the end of ten years, the company had in operation 4,484 miles of pole line and 13,148 miles of wire in its long distance service, and at the present time they have in the provinces of Ontario and Quebec 6,095 miles of poles, bearing 16,567 miles of wire.

Connections have been established with the extensive long distance system of the American Telegraph and Telephone Company and affiliated companies in the United States, at Newport, Vermont, St. Albans, Ogdensburg, Buffalo and Detroit, affording a system of direct telephonic communication as far south as Virginia and Tennessee, and from the cities and towns of the Atlantic seaboard westward to Nebraska.

The difference in the cost of the first long distance line of 1881 and the long distance line of to-day affords one of the serious problems in finance which the company has to meet. It is not a mere matter of change; it is a revolution requiring absolutely new and far more

expensive construction. In 1881 a No. 9 iron wire (288 lbs. to the mile) was the best in use. To-day most of the construction is of two copper wires (which together weigh 532 lbs. to the mile). Formerly 32 poles to the mile were sufficient, but with the introduction of copper, in order to reduce the strain upon the wire, 40 poles to the mile are used; the poles have to be set deeper in the ground and more carefully stayed, all of which greatly increases the cost.

The long distance central office equipment of to-day is much more expensive than it was ten years ago, improvements having been made to facilitate the work of operating and to secure the best results in communications. The astonishing results which the long distance telephone service of to-day affords is due as much to the improvement in instruments, switches and other apparatus, and to the system upon which these are employed, as it is to the improvement in the lines.

Many people suppose that the long distance telephone is a competitor of the telegraph, and they are unable to understand the cause of the difference in rates. The competition is largely, if not entirely, mythical, and the reason for difference in rates is easily explained. The telegraph employs a single iron wire conductor, and, by means of a quadruplex instrument, this single wire is made to serve the purpose of four wires. The long distance telephone service requires two copper wires for each circuit, which together weigh nearly double what the single iron wire does, and costs over five times as much per pound. The general construction and office equipment of the long distance telephone service is also far more expensive than that of the telegraph. Nor does the comparison end here. An ordinary ten-word telegram may be transmitted in one minute, and it is practicable to transmit four messages simultaneously over one wire. Each completed conversation over the long distance telephone occupies two wires for an average of ten minutes; the comparison, therefore, being two copper wires for ten minutes, as against one-quarter of a single iron wire one minute.

Another important difference arises from the essential difference in the two systems of communication. The sender of a telegram writes out his message and goes about his business, and the operator forwards it as other demands on the line will best admit, with slight reference to time, thus keeping the telegraph lines fully employed at all hours.

The correspondent by telephone must have the line when he requires it, or not at all, and practically the entire earnings of the long distance telephone line must be within such hours as business men generally are in their offices, the hours during which these lines are productive being thus limited; and, as has already been pointed out, the capacity of the long distance line being confined to an average of six conversations per hour, it is clear that the rate must be sufficient to yield during that time an adequate return upon the investment and expenses.

Telephone rates are based on mileage and the time the line is occupied. The parties to a conversation absolutely control the line for the whole distance between them, on the average, ten minutes (five minutes for the conversation and five minutes to arrange the connection and to disconnect the line). It follows that in equity they must pay for the investment they control for the time it is at their disposal. Therefore, distance and time must be the ruling factors in fixing the rates.

The telegraph and long distance telephone have distinct functions and serve a different purpose to the commercial world. The telephone has, in reality, created a business for itself. Time is, to-day, the prime consideration in the transaction of much business, and the long distance telephone obliterates both time and space. Retail merchants no longer carry the heavy stock of former years, but promptly supply the requirements of their customers through the connection the long distance telephone affords with the wholesaler. So, through every branch of business the telephone has become a distinct and indispensable factor, the usefulness of which will be extended as its possibilities become more generally known and recognized.

AN HISTORICAL CHAPTER ON THE STEAM ENGINE.

FOR the following historical chapter, which traces from B.C. down to the present time, in chronological order, the different stages the steam engine has gone through to make it what it is to-day, we are indebted to a treatise entitled "Smokeless Heat," issued by the General Engineering Company, of Toronto:

- 927 B.C.—Homer spoke of steam as we do.
- 390 B.C.—Plato described steam as water melted into air by heat, which could be compressed into water again.
- 222 B.C.—Archimedes is said to have used steam in his defensive engines.
- 150 B.C.—Hero is associated with the invention of the steam engine, although it appears to have been known 1,000 years before his time. He invented hot air, rotatory and idolatrous engines.
- 1543.—DeGary, a Spanish captain, proposed to propel ships by steam.
- 1601.—Porta, the inventor of the magic lantern, showed the relative volume and force of steam in raising water.
- 1612.—De Caus showed the power of the sun on confined water by lenses; to increase the sun's effect, water was forced up six feet in pipes.
- 1618.—David Ramsay obtained a patent for an engine to plough without horses, to raise water and propel ships and to raise water by fire from deep pits, move ships against wind and tide, and to fertilize the earth.
- 1629.—Branca describes a rotary steam engine he used for grinding drugs.
- 1648.—The suggestion of flying by high pressure steam and large wings was made.
- 1651.—Marquis of Worcester pumped water by steam engine.
- 1702.—Savary states, "My engine raises a full bore of water sixty or seventy feet high, and if strong enough I would raise water 500 to 1,000 feet high." Savary was the first to use guage cocks. It is related that Savary accidentally discovered the force of condensation of steam from a wine flask—not quite empty—being thrown on a fire and producing steam. He took it off the fire and immersed its mouth below cold water, which condensed the steam and filled the flask by atmospheric pressure.
- 1705.—Newcomen employed the air to perform the work of pumping water and steam only used as an auxiliary. Newcomen, by condensing the steam below the piston, forced it and that end of the beam down, whilst the elevation of the other end raised water from the mine. Steam was therefore used merely to raise the piston, and air to do the work.
- 1740.—Experiments made at Newcastle are said to have realized an evaporation of eight pounds water for one pound coal.
- 1757.—Fitzgerald added the fly-wheel to the engine.
- 1762.—Dr. Black investigated the properties of heat and steam and propounded the doctrines of latent heat.
- 1766.—Blakely introduced tubular boilers.
- 1770.—Cugnot, French engineer, made a model of a steam locomotive, and the French government constructed one at the Pasis arsenal and tried it in 1771, and then "laid it aside."
- 1772.—Smeaton determined the relative steaming values of different coals. Smeaton realized a duty of 112,500 foot pounds for one pound coal.
- 1730-1819.—The great defect of Newcomen's engine as improved by Smeaton was the loss of heat arising from condensing the steam in the working cylinder. James Watt estimated this to be nearly 35%, and in
- 1769.—Watt patented the addition of a separate condenser.
- 1782.—Watt invented the double acting cylinder, using steam on both sides of the piston.
- 1799.—Watt's assistant, Murdock, introduced the eccentric and slide valves. Watt invented the governor and throttle valve. To overcome a patent unfairly obtained through one of his workmen, Watt invented and used the
- 1780.—Sun and planet wheels in place of the crank. Watt claimed the crank was part of his design, but to avoid litigation used this arrangement.
- 1776.—Watt introduced the expansion of steam. He calculated when cut off at half stroke the performance would be as 1.7, at $\frac{1}{4}$ stroke as 2.4, and at $\frac{1}{7}$ as 3 in economy as compared with steaming the whole stroke. Watt was the first to recognize fully the importance of gaining some knowledge of the action of steam in the cylinder, and the first form of an indicator was the result of his efforts.

- 1776.—Bushnell proposed a screw propeller for ships.
- 1778.—Watt erected at Shadwick waterworks, an engine, working expansively.
- 1780.—Watt, by improved flue and other arrangements, obtained 8.6 pounds evaporated water per pound coal, or nearly 10% better than Smeaton.
- 1781.—Hornblower patented the same principle, expanding the steam into a second cylinder which led
- 1782.—Watt to patent his single cylinder plan of expansion. It cost Boulton, Watt's partner, \$400,000 to defend his patent rights and introduce his engines before any profit was realized.
- 1784.—James Rumsy exhibited on the Potomac a boat propelled by machinery. He exhibited a boat in which a pump worked by steam power drove a stream of water from the stern and thus furnished the motive power.
- 1786.—Symington tried to combine Newcomen's atmospheric engine with Watt's separate condenser, yet evade the patent, but failed to do so. Symington constructed the first paddle wheel steamboat of the modern class.
- 1791.—Street dropped turpentine on hot iron and exploded the vapour formed below a piston to produce motion.
- 1797.—Cartwright used metallic packing.
- 1790-1816.—Trevethick erected in connection with Watt's former workman, Bull, several engines with double-acting cylinders. This able engineer introduced high pressure steam and expanding to a low pressure. So marked was the economy that the Court of Spain sent him with regal honors to the silver mines in Peru to drain them.
- 1800.—Bell fitted a four horse power engine in a small vessel and sailed from the Clyde to the Thames at seven miles an hour.
- 1802.—Trevethick patented a road locomotive which was successfully tried near London.
- 1804.—Improving on this he completed a locomotive to draw coal. It worked well, drawing ten tons of iron at five miles an hour. Trevethick was the inventor of the first modern locomotive.
- 1804.—Oliver Evans showed wonderful grasp of the science, but for want of money he could not carry out his ideas. He used the exhaust steam to heat the feed water; he worked with high pressure steam. In the writer's opinion Evans has not got the credit he deserves.
- 1804.—Stevens, of Hoboken, with a Watts engine $4\frac{1}{2} \times 9$, supplied with steam from a boiler consisting of eighty-one horizontal copper tubes one inch diameter and two feet long, propelled a steamboat four miles an hour by a screw.
- 1793-1807.—Fulton successfully introduced steam boilers on the Hudson.
- 1815.—Ralph Dodd put a fourteen h. p. engine into a seventy-five ton boat and made a trip of 758 miles in 122 hours in very stormy weather.
- 1807.—M. DeRevax moved a locomotive carriage by exploding a mixture of hydrogen and air in a cylinder by electricity.
- 1813.—Blackett demonstrated that the enormous weight of the adhesion between the smooth rails and the equally smooth wheels would suffice to prevent the wheels of a locomotive from slipping.
- 1814.—George Stephenson ran his locomotive "Blucher" on the Killingworth railway.
- 1818.—Napier successfully prosecuted steam navigation and in
- 1822.—The "James Watt," of 100 h. p. and 440 tons burden, ran from Leith to London at ten miles per hour.
- 1824.—Brunel tried a carbonic acid gas engine.
- 1829.—Stephenson obtained the prize of £500 for constructing and running his locomotive "Rocket" over a distance of thirty miles in two hours and seven minutes. This test was between the "Sanspareil" built by Hackworth, and the "Novelty" built by Ericsson, and was to be a run of thirty miles at not less than ten miles per hour backward and forward along a mile level, with a load three times the weight of the engine. The "Novelty" after running twice along the level was withdrawn, owing to the failure of the boiler plates. The "Sanspareil" traversed eight times at a speed of nearly fifteen miles an hour and was stopped owing to the machinery being deranged. The "Rocket" was the only one to stand the test. The maximum speed was twenty-nine miles per hour and the minimum twelve. Stephenson made a splendid reputation, and projectors of all kinds, together with young men, asked his advice and counsel. This he gave cheerfully, except when these youths were "affectedly dressed," and put on "airs" contrary to his notions of propriety. To one youth applicant of this stamp he said: "I hope you will excuse me, I am a plain spoken person, and am sorry to see a nice-looking and rather clever young man like you disfigured with that fine patterned waist-coat and all these chains and fang-dangs. If I had bothered my head with such things when at your age I should not be where I am now."
- 1829.—Ericsson introduced hot air as a competitor with steam.
- From 1829 until the present date the history of the locomotive is a vast series of improvements in details, far too various and numerous to mention here, until now it is one of the most perfect and beautiful of all the machines with which the engineer has to deal, and of which he is justly proud.

CORRESPONDENCE

CONVERSION OF WAVE FORCE INTO MECHANICAL FORCE.

CALGARY, N.W.T., March 4th, 1898.

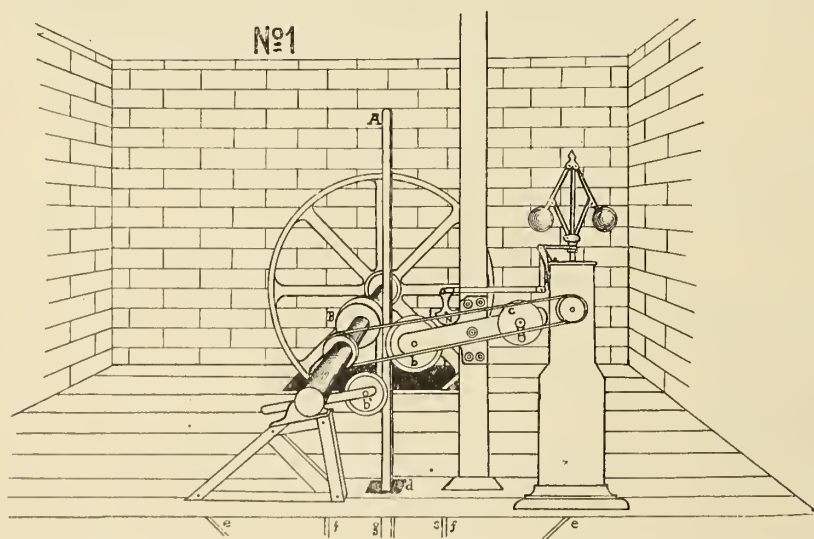
To the Editor of the CANADIAN ELECTRICAL NEWS:

DEAR SIR,—While perusing the contents of the Toronto World of the 15th of January, 1898, I came across an article headed, "Thomas A. Edison, Jr., thinks he has a plan to harness old ocean for man's benefit." Now, sir, Thomas A. Edison, Jr., is not the only individual who has solved this problem, as I believe I have plenty of evidence to prove.

About five years ago I showed this same plan of applying wave force to mechanical appliances to Joseph Powell, an architect and civil engineer, of Hamilton, Ont., and endeavored to persuade him to start a company to finance it and take out patents, but he said that it would require such a large amount of money that he could not get anyone to take hold of it. I showed him how it could be used to generate current for the Pacific cable at the intermediate stations in the Pacific Ocean, and thereby save the shipping of coal to these stations; also that wherever a body of water existed that had any swell or roll whatever on its surface, how it could be used or applied for lighting, heating, cold storage, and other mechanical uses, and this by the very same plan as mentioned in the article in the World, viz., floats connected or rather held in position by a pier, these floats to have a lever to each one, one end of each of these levers to be connected to a float, the other end connected to either a piston, a rack or a clutch-rod, and, of course, the lever working on a fulcrum. I showed him how it could be used: first, to compress air; second, raise water to a higher plain; third, compress ammonia; fourth, with the rack or clutch-rod for direct connection with dynamic or other machinery; the first to be used in connection with air engines, the second for turbines, the third for cold storage, and the fourth as stated.

I also spoke about it to a man named Moses, who was the inventor of the "Moses" stove; he had a hardware store on Yonge street, Eglington. I approached him with reference to having tin pump cylinders made for a model, but which I did not get, as I used the clutch-rod. I also spoke to Mr. Oldfield (proprietor of the Anglo-American Novelty Co., formerly on Lombard street, then on Adelaide street east) about the same invention, and roughly described it to him one day in the Yonge St. Arcade. I also mentioned the fact that I had solved the difficulty to G. Clay, accountant, Yonge St. Arcade, and I know I have mentioned it to others.

I conceived the idea about ten years ago while watching the landing stage at Liverpool, England, where the ferry-boats run

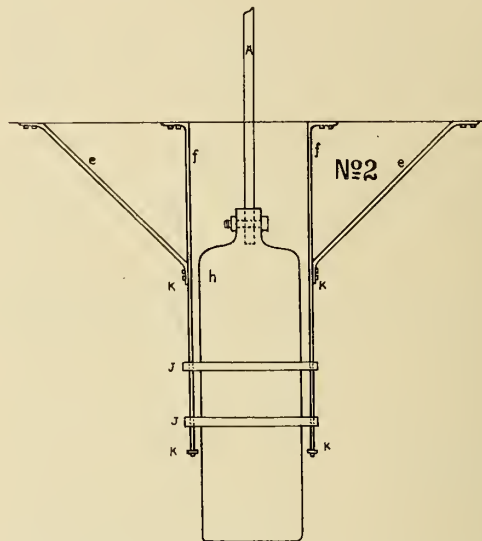


alongside and discharge their passengers. This landing-stage is thousands of tons, I believe, and is lifted up and lowered down by floats, as the tide varies.

Lastly, I wrote Thomas A. Edison about this matter near the close of the year 1896 or beginning of 1897, but I do not remember giving him any details whatever. I obtained Mr. Edison's address from Mr. Haines, the book-keeper for Matthew Bros. & Co., 48 Temperance street, Toronto, and told him I was writing Edison about an invention. I also told H. Matthews the same thing. However, Mr. Edison never acknowledged receiving my

letter. Three years ago, while in charge of the North Toronto Electric Light and Waterworks, I had a model running on this same plan.

I send you tracings of my original apparatus. No. 1 gives a general idea of how the wave motion is converted by rods (of which there may be any number) A, g, into circular motion by friction between it and pulley B. The pulleys b and b' are simply accessories to insure, first, instant release immediately rod commences to descend, and second, a firm grip on B when ascending. As you will see, the pulley b is so inclined that by any upward movement it must press against the rod A and thereby cause it to grip the pulley B; the pulley b is held in position by arm and counterbalance c. The pulley b' is similarly inclined, but in opposite direction to pulley b, so that any downward



movement of rod A tends to move it on its arm downwards, and in so doing throws or pushes the rod A away from pulley B. The governors act through the levers shown on the cam N in such manner that when the required speed is reached the cam presses down on the arm which supports pulley b, and prevents pressing rod A against B. Of course, it must be understood that there can be any number of rods, so as to obtain continuous and steady motion.

Tracing No. 2 is a general idea of floats, of which there may be any number, and also of any size or tons displacement. They may be braced to suit requirements. A is the rod which may transmit the motions through the other levers or direct to mechanism, as, for instance, through B to C, Fig. 1.

The bands, J, J, No. 2, are so constructed as to form runners on guides, f, f. K, K, are stops, which might be provided with spiral springs, to form a cushion and prevent a jar or shock, when the float was lifting and falling its whole capacity, but there would require a harbor to be built around the station, and if the harbor was properly constructed with gates, the "rise" and "fall" could be so modified as to always, except in calms, have the floats rise and fall about the same distance, no matter how stormy it was outside of the harbor.

In conclusion, permit me to repeat that I know this is practicable, although, like everything else, or other first ideas, it can be improved upon. I think I have an improvement myself, but a model of this one has worked, and apparently worked well. From the World's description, Edison's idea is a similar one, and no doubt, as it is connected with his great name, he will get all the honor, and the world will wonder how his brain

could grasp or conceive such a "mighty" simple thing; and of course, why it is absurd that any one else could do the same.

Yours respectfully,

WM. CROSS, C.E.

Of the forty-two largest cities in Japan, from Tokio, with 1,368,000 population, down to those of 26,000, electric lighting systems are installed in twenty-four, eighteen being without electric lights.

CORROSIVE AND SCALE-FORMING AGENTS IN BOILER FEED WATERS.

By Wm. Thompson.

[ARTICLE 4].

CHEMICAL analysis of a boiler feed water not only enables the chemist to determine the quantity of foreign matter present, but also the condition or form in which it appears as an impurity; it also enables him to express with certainty an opinion as to the nature of scale that will be found and quantity that may be expected, and thus judge as to the suitability or otherwise of a water for boiler feed purposes. For purposes of illustration I have chosen a number of characteristic samples of water, all of which have, in some respects at least, different properties.

No. 1 is a sample of water from an artesian well in the eastern portion of the city of Montreal that shows an almost entire absence of lime and magnesia salts, but which is still strongly impregnated with impurities. A partial analysis shows this water to contain:

Total solids per imperial gallon.....	36.42 grains.
Made up as follows:	
Sodium chloride (salt).....	2.32 "
Sodium sulphate.....	6.85 "
Alkaline carbonates and bicarbonates with traces of silica.....	27.25 "

The whole of the foreign matter contained in this sample of water consists of soluble salts in chemical solution, that is to say, salts that have a very high degree of solubility in water, and consequently precipitation of impurities as scale-forming agents cannot occur. Although this is positively a non scale-forming water, it cannot be classed as a good or even fair water for boiler feed purposes in its original form. A glance at its composition shows it to be strongly alkaline and liable to cut the boiler and boiler fittings. As a matter of fact this is what occurred in actual practice, and users found it impossible to use the water satisfactorily until impurities had been neutralized by chemical treatment.

No. 2 is a sample of water from an artesian well used to supply the town of Montreal West, and may be classed as a fair boiler feed water. As will be seen, this water is very rich in dissolved solids, and also contains a fair percentage of scale-forming material. Partial analysis shows it to contain:

Total solids per imperial gallon.....	96.2 grains.
Made up as follows:	
Insoluble suspended matter.....	1.00 "
Alumina and peroxide of iron.....	.20 "
Carbonate of lime.....	5.20 "
" " magnesia.....	3.17 "
Sulphate of soda.....	13.49 "
Chloride of soda.....	60.60 "
Alkaline carbonates and bicarbonates.....	12.54 "

Here we have an example of water that actually contains scale-forming agents and at same time material necessary to prevent formation into hard scale when precipitated. This water showed in use results that might be anticipated from its composition, precipitating a heavy insoluble sludge at lowest part of boiler, and after boiler had been in use a short time water became both highly concentrated and strongly alkaline, although the boiler was only evaporating about 700 gallons of water per day; a sample of water drawn from the boiler three weeks after being put in use, analysis showed it to contain an enormous amount of dissolved solids held in solution, composition of impurities being as follows:

Total solids per imperial gallon.....	2796.36 grains.
Insoluble suspended matter.....	6.72 "
Chloride of soda.....	1940.40 "
Sulphate of soda.....	425.28 "
Alkaline carbonates and bicarbonates.....	398.48 "
Hygroscopic water.....	25.48 "

So strongly alkaline had the water become that brass fittings on boiler were being attacked, and wherever a small leak occurred deposits formed on outside of boiler, which is a marked characteristic of the behaviour of the soda salts. At no time, however, during the last four years has any scale been found, a heavy sludge precipitating, having the following composition:

Silica.....	6.44%
Alumina and peroxide of iron.....	16.32%
Carbonate of lime.....	54.92%
" " magnesia.....	7.40%
Sulphate of soda.....	2.37%
Chloride of soda.....	10.80%
Carbonates of soda and potass.....	1.25%

The presence of the soluble soda salts in the sludge may be explained by remarking that the sludge was of such a consistency that a quantity of water had to be withdrawn at all times with the sludge. Until the composition of impurities contained within this water was known a great deal of difficulty was experienced in its use, particularly by foaming. The only treatment required, however, is to keep the water within the boiler from becoming too concentrated by frequent blowing off, and good results are now being obtained from its use.

Samples 1 and 2 mark distinct classes of feed waters. In No. 3 we have a sample of water of another type, an excellent water for boiler feed purposes and used largely by both the Grand Trunk and Canadian Pacific railway companies, for use in the boilers of their locomotives. This sample was obtained from Brampton, Ont., and is supplied to the town by means of gravitation from a small lake situate a few miles north of the town. Analysis shows it to contain but a small quantity of dissolved solids and to be remarkably free from lime and magnesia salts, composition of impurities being:

Total solids per imperial gallon.....	6.00 grains.
Insoluble suspended matter.....	.40 "
Carbonate of lime.....	2.85 "
" " magnesia.....	.30 "
Chloride of soda.....	1.20 "
Sulphate of soda.....	.48 "
Alumina and peroxide of iron (traces)	

This is a type of feed water that tends to make engineers happy and requires but occasional washing out to dispense with either chemical or mechanical treatment.

Samples No. 4, 5 and 6 show examples of scale-forming waters in various forms.

No. 4.—Sample from Walkerton, Ont., shows a water rich in lime and magnesia salts existing in solution in the water as bicarbonates and precipitating as their respective carbonates:

Total solid per imperial gallon.....	21 grains.
Insoluble suspended matter.....	.80 "
Carbonate of lime.....	12.12 "
" " magnesia.....	6.66 "
Chloride of soda.....	1.20 "
Also traces of alumina and peroxide of iron.	

Sample No. 5.—Sample of water from artesian well in eastern portion of the city of Montreal:

Total solids per imperial gallon.....	43.7 grains.
Insoluble suspended matter.....	2.04 "
Carbonate of lime and magnesia.....	14.32 "
Sulphate of lime.....	12.65 "
Chloride of soda.....	9.38 "
Alkaline carbonates and bicarbonates.....	5.31 "

Sample No. 6.—Sample of water from factory at New Toronto, Ont.:

Total solid grains per imperial gallon.....	141.6
Insoluble suspended matter.....	1.00
Alumina and peroxide of iron.....	.80
Carbonate of lime.....	27.48
" " magnesia.....	20.45
Sulphate of lime.....	37.36
Chloride of soda.....	54.60

A review of the impurities contained in these various samples shows very clearly how important this part of our subject becomes, and how widely different and varied in quantity are the impurities contained in the various feed waters throughout the country. I have said that when the nature of the impurities present is known that the effects resulting from the use of various waters for boiler feed purposes can be ascertained. This is well illustrated by the results obtained from the use of the various samples chosen for purpose of illustration from a large number of feed waters examined in my laboratory.

No. 1 and 2 I have already referred to at length. No. 3 is a class of water occasionally met with and predominating in some districts, and is a type of excellent water for the purpose indicated, and may be used without previous treatment with safety.

No. 4 is also a good boiler feed water, containing the whole of its impurities in such a condition that a physical change is all that is needed to render greatest portion of impurities insoluble, and consequently in such a condition that mechanical filtration will remove them from the water. As a matter of fact the users complain that while they had no scale in their boilers a very heavy scale formed in the heater, sample of which I received and analyzed with the following result:

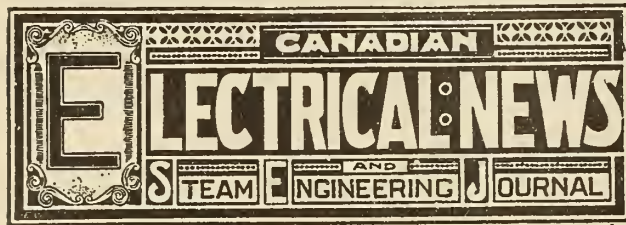
Insoluble.....	.38%
Alumina and peroxide of iron.....	1.10%
Carbonate of lime.....	92.08%
" " magnesia.....	5.60%

Scale was light, very porous, and easily removed, and is a good example of the change taking place as set forth in last month's contribution on this subject when the water is sufficiently heated to drive off excess of carbonic acid and the insoluble carbonates of lime and magnesia are at once precipitated.

Sample 5 shows a type of water that has actually a double effect, a reaction setting up between the alkaline carbonates and the sulphates of lime and precipitating a sludge balance of sulphate of lime bonding with carbonates of lime and magnesia and forming heavy scale.

Sample 6 shows a sample of water that belongs to a class that should not be used for boiler feed purposes if any other water can be obtained, and requires both chemical and mechanical treatment, scale formed from this water, as is to be expected from composition of impurities, being exceedingly hard, tenacious and troublesome.

(To be Continued.)



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THE series of instructive articles on electricity and steam engineering by Mr. Wm. Thompson, which have appeared in our Educational Department each month during the last year, will shortly come to a close. We have received assurances from many quarters as to their practical value. The object in their preparation was to furnish, in a form to be easily understood by those who had not the advantage of a technical education, the underlying data and principles on which a thorough knowledge of these subjects must rest, and which of itself would prove extremely helpful to those desirous of fitting themselves to intelligently operate electrical and steam machinery. Our readers of this class will no doubt be pleased to learn that this series of articles will shortly be published in the form of a pocket hand-book, at a very moderate price. Further particulars will shortly be given in these columns.

To Our Readers.

ARRANGEMENTS are well under way for the holding of what is termed a Greater Britain Exhibition at Earl's Court, London, next year, lasting from May until October. The undertaking, which is under the direct management of the London Exhibitions, Limited, a company formed in 1894, and having a paid-up capital of £145,000, is receiving the approval and support of the Marquis of Lorne, Sir Charles Tupper, and other distinguished British and Colonial statesmen. The object, which is to bring together the products of the various parts of the British Empire, should commend itself to all who wish for a closer commercial relationship between Great Britain and her colonies. The Canadian government will be asked to grant an appropriation to cover the cost of a Canadian exhibit. Attention is called to the fact that exhibits intended for the Paris Exhibition of 1900 might with advantage and little additional cost be first shown at the London Exhibition. In view of the prevailing sentiment on both sides of the water in favor of closer trade relations, Canada should take advantage of every opportunity to make known her resources.

Proposed Greater Britain Exhibition.

Acetylene Gas. APROPOS of the article published in a recent number of the **ELECTRICAL NEWS** anent the dangers attending the use of acetylene gas, we reprint from the daily papers the following despatch dated Guelph, March 23: "A show, the Erin & Brennan Co., appeared in the City Hall here last night. There was one real act in the show not on the programme. An acetylene gas generator exploded during the early part of the proceedings. One of the performers was passing the generator with a lighted candle, which ignited the escaping gas. Explosion after

explosion followed, and some of the scenery took fire. Mr. Brennan, one of the company, and caretaker Ryde, managed to smother the flames. Ryde had his hands badly burned by carrying the tank down-stairs. The stage carpet, piano cover and a couple of sets of scenery are badly scorched." Apart from the dangerous character of acetylene, it is being found out now that it cannot compete with a fairly reasonable supply of electric light or gas from a central station. In everyday practical operation it costs more than either, with the trouble and stench extra, as witness the following extract from the Kincardine Reporter: "The Teeswater News has just had an interview with Mr. Brick regarding his experience in lighting the Vendome, one of the finest hotels in that section of country. Not being able to make good arrangements for lighting by electricity, Mr. Brick contracted for a 75 light acetylene gas plant, the fittings costing \$175. The generator was outside in a separate frost-proof building, partly to meet insurance requirements and partly to obviate the objectionable stench in cleaning it out daily. After a trial of over three months Mr. Brick has discarded the acetylene gas plant, and has had the entire hotel fitted up with 66 incandescent electric lights from the town plant. He claims that electricity is not only cheaper than the gas, but that the objection to the acetylene is its offensive smell, its getting out of order, emitting a sooty discharge from the burners, and the amount of work necessary to keep the generator charged, all saved under the incandescent electric lighting system."

**The Rights of Private
Lighting and Water
Companies.**

In Pennsylvania the Courts have restrained municipalities from entering into competition with private water supply companies. In the New York Legislature a Bill has been introduced which seeks to add the following sub-division to the general corporation law: "Whenever any corporation shall be in the possession of or entitled to any rights, privileges or franchises within the limits of any municipal corporation, and shall be engaged in the exercise of the same or any part thereof, the municipal corporation within whose limits such rights, privileges or franchises are owned or exercised, shall not itself undertake to perform, within any land or territory, within which such corporate rights, privileges or franchises are or may be owned or exercised, the business or purposes to which said corporate rights, privileges or franchises relate, without first acquiring, in the manner prescribed by chapter 23 of the code of civil procedure, the rights, privileges and franchises of said corporation, or to which said corporation is or may be entitled, and also the property of said corporation used in or necessary for the use or exercise of any of said rights, privileges and franchises." Legislation of similar character has already been enacted by the State of Massachusetts and by the British Parliament. With such a precedent before them, it is to be hoped the Ontario Legislature at its next session will accede to the request of the Canadian Electrical Association, representing the electric light and gas companies, for legislation which will render compulsory the purchase by municipalities at a valuation of the plant only of private companies whose business they may desire to assume. It will be observed that no effort is being made on behalf of these companies to prevent municipalities from engaging in the business of supplying electric light and gas. All that is asked is that in cases where a municipal

corporation desires to usurp the functions of a private company, they shall be compelled to purchase only the plant of said company at a fair valuation to be fixed by arbitration. Legislation of this character is needed to prevent the wiping out of a large amount of private capital which was invested in electric light and gas plants at a time when such investments were attended by heavy risk and when no one supposed that money of the taxpayers, including, of course, those who had invested their means in the private company, would in some instances be employed to purchase and operate a competing municipal plant.

**Steam vs. Heat
Engines.**

WE often see in the various papers as read at some of the engineering societies statements regarding the great inefficiency of the steam engine, and that there is considerable room for improvement. No just comparison can be made between any machine and a heat engine, and to say that the steam engine is very inefficient is only partially correct. Some engines as mechanical devices give efficiencies as high as 90%, which certainly does not leave a very large margin for improvement. The amount of work got out of a heat engine depends entirely on the ABSOLUTE temperatures between which it is worked, and to obtain the whole work from a mass of heated air, it would be necessary to cool it down to absolute zero, which is utterly impossible in practice. The work done or given out by a heat engine in one revolution is expressed as follows:

$$W = J H \left(\frac{T_2 - T_1}{T_2} \right)$$

Where J = Joule's mechanical equivalent.

H = Heat units given up.

T₁ = Final absolute temperature.

T₂ = Initial absolute temperature.

From which we get the efficiency as being $\frac{W}{J H} = \frac{T_2 - T_1}{T_2}$

Suppose the initial pressure in a steam cylinder were 100 lbs., and the final pressure 5 lbs., and treating it as a heat engine we have an efficiency of $\frac{797 - 687}{797} = .14$, when

797 and 687 are the absolute temperatures of steam at 100 lbs. and 5 lbs. respectively. Now this same engine may have a mechanical efficiency of 85%. It is through no fault of the engine that its efficiency is low, when treated as a heat engine, but is the result of a law in thermodynamics, where only a fraction of the heat supplied is available for being transformed into another form of energy; this fraction is as shown above, viz., $\frac{T_2 - T_1}{T_2}$, Joule's mechanical equivalent being 772 foot

lbs. One h. p. hour is equal to 2565 heat units. Taking a very economical plant, where 2 lbs. coal are required per indicated horse power, and that the calorific value of the fuel is 12,000 heat units, we therefore get for every 24,000 heat units in the furnace, 2565 heat units at the engine. But the boiler only utilizes .75 of the total heat units; we therefore have .75 of 24,000 = 18,000 heat units in the boiler, giving us an efficiency of $\frac{2565}{18000} = .15$ nearly. Considering this in another way, we have steam pressure 120 lbs., engine compound condensing, vacuum 26 inches. The absolute temperatures corresponding to these pressures are 810 and 586 respectively, giving an efficiency of 27%. Twenty-seven per cent. of 18000 is equal to 4860 heat units, and of this amount 2565 are converted into mechanical energy, showing clearly that the correct efficiency of this engine, working under these conditions, is $\frac{2565}{4860} = 52\%$.

SOME EXPERIMENTS ON THE CONDENSATION OF STEAM.*

By H. L. CALLENDAR, M.A., F.R.S., Professor of Physics, and J. T. NICOLSON, B.Sc., Professor of Mechanical Engineering, McGill University, Montreal.
PART I.

As the result of some experiments by electrical methods on the measurement of the temperature changes of the walls and steam in the cylinder of a working steam engine, which were made at the McDonald Engineering Building of McGill University in the summer of 1895, the authors arrived at the conclusion that the well-known phenomena of cylinder condensation could be explained, and the amount of condensation in many cases predicted from a knowledge of the indicator card, on the hypothesis that the rate of condensation of steam, though very great, was not infinite but finite and measureable. An account of these experiments was communicated to the Institution of Civil Engineers in September, 1896, and will, it is hoped, be published in the course of the ensuing session. In the meantime, the authors have endeavored to measure the rate of condensation of steam under different conditions by a new and entirely different method, with a view of verifying the results of their previous work, and also to estimate the influence, if any, of the film of water adhering to the walls of the cylinder.

In considering the condensation of steam on a metal surface it is usually assumed that the surface exposed to the steam is raised up to the saturation temperature corresponding to the pressure of the steam, and that the amount of condensation is limited by the resistance of the water films to the passage of heat from the steam to the metal and from the metal to the water. If the steam contains air, there may also be a considerable resistance due to the accumulation of a film of air on the surface, but it is comparatively easy to exclude this possibility in experimental work.

In the steam engine experiments above referred to, it was practically certain that the water film due to the cyclical condensation never exceeded one-thousandth of an inch in thickness, and that the resistance offered by it was unimportant. At the same time, it appeared clear that the temperature of the surface of the metal at its highest was considerably below the saturation temperature of the steam, a condition which could only be explained by supposing the rate of condensation of steam on a surface to be limited by some physical property of steam itself, apart from the resistance of the condensed film of water. Interpreted in this manner, the experiments led at once to the conclusion that the rate of condensation at any moment was simply proportional to the difference of temperature between the saturated steam and the surface on which it was condensing.

The limit thus found was shown to be capable of explaining many of the phenomena of cylinder condensation in a rational manner, but the method by which it was established was of an indirect and somewhat intricate character, and appeared to require some simple and more direct confirmation.

If the rate of condensation of steam were really infinite, it should be possible by a suitable modification of the surface-condenser method (i.e., by getting rid of the water films on the outside of the tubes) to obtain values of the condensation considerably in excess of those given by the formula deduced from the temperature cycle observations.

To accomplish this it is necessary to eliminate as completely as possible the resistance to the passage of heat through the water films between the steam and the metal, and between the metal and the circulating water, and at the same time to measure as accurately as possible the temperature of the metal.

These conditions led to the form of apparatus which was employed. The resistance to the passage of heat from the metal to the condensing water in this apparatus is practically eliminated by employing a thick cylinder, 5 in. diameter and 2 ft. long, with a screw thread cut on its outer surface. Water from the high-pressure mains is forced to circulate round this surface with a very high velocity in the narrow space between the cylinder and the surrounding tube. In this manner it is possible to obtain a very uniform temperature for the external surface differing but little from that of the circulating water.

If the cylinder is made sufficiently thick, its temperature may be approximately determined at any depth by inserting mercury thermometers. It was intended at first to use thermocouples for this purpose, but the apparatus in this form would have been unsuitable for students' use in the ordinary course of laboratory work, which was one of the primary objects in view in the construction. It would also have been desirable to make the cylinder of nearly pure copper, which would have reduced the re-

sistance of the metal to the lowest point. The authors were compelled, however, to content themselves for the time with cylinders of cast iron and mild steel.

The internal surface of the cylinder, upon which the steam was condensed, was a hole one inch in diameter, drilled in the solid metal. In order, as far as possible, to minimize the resistance of the surface film of condensed water, a revolving brush was constructed of very thin strips of steel to wipe the surface five or six times a second. This wiper was found to wear in a very short time to so perfect a fit, and the water film must have been so energetically stirred, that its resistance to the passage of heat must have been far less than that of the best conducting metal, when there was perhaps some small film present.

Under these conditions, if the rate of condensation of steam were infinite, it should have been possible to obtain a rate of condensation many times greater than the limit deduced from the cylinder condensation experiments above mentioned.

On making the experiment, however, it was found that the wiper made very little difference to the amount of condensation. With the wiper revolving at the rate of 160 per minute, the condensation was increased by about 5 per cent. on the average of several experiments. It may be concluded from this that the drops of condensed water with which the surface is partially covered are in such rapid motion that they do not appreciably obstruct the passage of heat from the steam to the metal. In fact, Prof. Callendar actually found that the drops increased the condensation. A film of the same average thickness, if it were absolutely quiescent, and if its conductivity, as generally estimated, were only one-hundredth of that of cast iron, would no doubt prove a serious obstacle; but, as a matter of fact, the viscosity of water at these temperatures is so small, and the motion so rapid, that the drops cannot be treated as a quiescent film.

The temperature at various distances from the inner surface of the cylinder was determined by means of mercury thermometers inserted to a depth of 8 in. or 9 in. in holes drilled parallel to the axis. From the temperatures so observed the conductivity of the metal and the temperatures of its inner and outer surfaces could be approximately inferred. It was found, however, that the presence of the holes interfered materially with the flow of heat through the metal, and that the readings of the thermometer under these conditions were not altogether trustworthy.

From a number of observations on the cast-iron cylinder a conductivity of 5.5 thermal units Fahr. per square ft. per minute per deg. Fahr. per inch was deduced, a result which agrees very closely with the authors' previous determination by a different method. For the steel cylinder a conductivity of 5.8 was similarly deduced. These results apply to a mean temperature of about 140 deg. Fahr., and are much lower than the values generally assumed for iron.

In order to verify the previous results as to the rate of condensation of steam derived from the steam engine experiments, the temperature of the inner surface of the metal was calculated on the assumption of a rate of condensation equivalent to 0.74 thermal unit Fahr. per second per square foot per deg. Fahr. difference of temperature. The values so found agreed with the observed temperatures within the limits of error of the observations. Owing to the inferior conductivity of the iron the test was not absolutely conclusive, as the difference of temperature between the steam and the surface rarely amounted to as much as 30 deg. With a cylinder of pure copper, and thermocouples for determining the temperature at a given depth, it should be possible to obtain a more certain confirmation by this method.

In performing the experiments a number of variations in points of detail were introduced from time to time. The flow of the circulating water was varied in velocity and directed in different ways. In order to secure uniformity in the distribution of temperature measured in different directions from the centre, the spiral circulation was found to be essential. In the second apparatus the screw thread was at first replaced by a baffle-plate, which was intended to direct the water into a spiral course, but the results found were unsatisfactory.

In some cases steam was admitted from the top of the apparatus and in other cases from the bottom. With the steam supply at the bottom, it was found that condensed water refused to drain down the vertical 1 in. tube in opposition to the current of steam, although the maximum velocity of the steam could not have exceeded 10 ft. per second.

The following set of observations, each of which represents the mean of several taken on similar conditions, will sufficiently indicate the general nature of the results:

The temperatures of the metal at distances of 1 in., 1.5 in. and

* Paper read before the Institute of Civil Engineers, London, England.

2 in. from the axis of the bar were observed by means of mercury thermometers, which were very carefully centred by small iron washers in holes filled with mercury. The hole fitting the bulb of the thermometer was 3-16 in. in diameter. The other holes were 5-16 in.

It will be observed that in this particular set of experiments the temperatures at 1 in. in the metal, when calculated to agree with the assumed rate of condensation, are all too low as compared with those observed, whereas the temperatures similarly calculated at 1.5 in. are all too high. This might at first sight appear to indicate a very rapid diminution of the conductivity with rise of temperature; but after making various tests the effect was traced partly to the disturbance of the heat flow caused by the presence of the holes, and partly to differences of density of the bar in directions at right angles. The latter differences were not observable in the case of the cast iron.

The observations taken at different pressures do not indicate any marked difference in the rate of condensation per degree second. These results, so far as they go, are in agreement with the authors' previous work, but they hope to obtain more conclusive evidence.

AN ELECTRICAL METHOD OF MEASURING THE TEMPERATURE OF A METAL SURFACE ON WHICH STEAM IS CONDENSING.

By H. L. CALLENDAR, M.A., F.R.S., Professor of Physics, McGill University, Montreal.
PART II.

The objects of the following experiments, which were made at the McDonald Physics Building with a different apparatus, was the measurement of the temperature of the metal surface itself by a more direct and accurate method. It was also desired to verify as exactly as possible whether the rate of condensation of steam at atmospheric pressure was the same as at the higher temperatures and pressures at which most of the preceding experiments were made.

The condenser used for these experiments was a very thin platinum tube, 1/4 in. in diameter and 16 in. long. The thickness of the tube was only six-thousandths of an inch, and the greatest difference of temperature between its inner and outer surfaces at the maximum rate of condensation observed in the experiments could not have been greater than 1/4 deg. cent.

The mean temperature of the metal itself was determined in each case by measuring the electrical resistance of that portion of the tube on which the steam was condensing. The author has had considerable experience in the employment of this method, which, moreover, is very easily applied if suitable apparatus is available.

The platinum tube was enclosed in an outer tube of brass or glass, and steam was admitted to the space between the two tubes. A steady current of condensing water was maintained through the platinum tube. The amount of condensation could be inferred by measuring the flow of water, and observing the difference of temperature between the inflow and outflow. In many cases the condensed water was also measured. Applying a small correction for radiation, the two methods always agreed with one-half of 1 per cent. The pressure of the steam in the outer tube, which was never far from the atmospheric, was observed by means of a mercury column.

The conditions of the experiment as to flow of water and steam, size and length of the external tube, etc., could be varied within certain limits. The following is a summary of the more interesting results obtained :

CONDENSATION RESULTS SUMMARY. MILD STEEL BAR. WIPER REMOVED.

Condensation. Thermal Units per Square Foot Second.	Steam Temperature Observations.	Surface Temperature Calculations.	Difference, Steam and Surface.	Temperature in Metal at Distances.						Conductivity, K.
				1 in.		1.5 in.		2 in.		
				Calcula- tions.	Observa- tions.	Calcula- tions.	Observa- tions.	Calcula- tions.	Observa- tions.	
20.0	deg.	deg.	deg.	deg.	deg.	deg.	deg.	deg.		
17.8	330	303	27	208	214	154	152	113	5.84	
15.7	300	277	23	193	198	143	142	109	5.66	
15.7	274	253	21	179	184	136	134	103	5.81	

1. With a short length of condenser and a very free escape of steam, the condensation observed was equivalent to 22.2 thermal units Fahr. per square foot per second, for a difference of temperature of 28.5 deg. Fahr. between the steam and the metal surface. This is equivalent to a rate of condensation of 0.78 thermal unit Fahr. per degree second, reckoned per square foot of the surface of the metal. This was the smallest value of the rate observed.

The platinum tube was vertical, and the current of steam downwards, conditions which tended to keep the surface of the metal comparatively clear of condensed water.

2. With the same conditions, but with a length of tube nearly twice as great exposed to the steam, the condensation observed was 22.3 thermal units Fahr. per square foot per second, for a difference of temperature of 25.3 deg. Fahr. This gives a rate of 0.88 per degree second. The lower half of the tube was more thickly covered with water than the upper half, the steam also was full of flying spray, which may have assisted in conveying heat to the metal, and in maintaining the same rate of condensation on the lower half of the tube as on the upper half, in spite of the somewhat higher temperature of the circulating water in the lower half.

3. With the same arrangement, but with the steam current reversed and reduced until the escape was as gentle as possible consistently with keeping the tube full of steam and entirely excluding air, a somewhat larger rate of condensation was observed, namely, 23.6 thermal units Fahr. per square foot per second. The pressure throughout the tube was very nearly atmospheric, and the gentle upward current of steam tended to keep the tube very thickly covered with drops and rivulets of water. The difference of temperature was only 22.0 deg. Fahr., giving a rate of condensation of 1.07 thermal units Fahr. per degree second. This is equivalent to 2.25 watts (joules per second) per square centimeter per 1 degree cent., and was the largest value observed throughout the work. It would appear probable that the surface exposed by the drops is so much greater (in the present instance about twice as great) than the surface of metal, and the drops themselves are in such rapid motion, that the increase of surface, by facilitating condensation, more than compensate for any resistance which the water film may offer to the passage of heat to the metal.

4. To verify this view the outer glass tube was replaced by a much smaller tube, so as to leave very little space for the steam current. The pressure of the steam was thus raised to nearly 4 in. of mercury above the atmospheric at the entrance of the tube, and the surface of the platinum was violently scoured by a spiral rush of steam and spray. Under these conditions the condensation observed was reduced to 19.2 thermal units Fahr. per square foot per second, instead of being increased as might naturally have been expected with so strong a current of steam. The effect of the energetic scouring of the metal surface was shown by a slight rise of temperature of the metal as compared with previous experiments. The observed difference of temperature between the metal and the steam in this case was 19.8 degrees Fahr., giving a rate of condensation of 0.97 thermal unit Fahr. per degree per second.

From these and similar observations in which the conditions of the experiments were varied to a certain extent in points of detail, it may be concluded that the presence of water on a metal surface may tend to increase rather than diminish the amount of condensation. The rate of condensation of steam at 212 deg. Fahr., allowing for the fact that in these experiments the surface was unduly increased by the presence and the motion of the water drops, would appear to be at least of the same order of magnitude as the value deduced from experiments on the cyclical condensation in the cylinder of a working steam-engine, in which the temperature of condensation varied from 290 degrees to 330 degrees Fahr., and the rate deduced was 0.74 thermal unit Fahr. per square foot per degree per second. Since, however, it is impossible that the latter value was diminished to an uncertain extent by a slight film of grease on the hot and dry surface, and since the value deduced from the surface condenser method is, perhaps, a little too large, owing to the presence of the water film, it would be unsafe to conclude that the rate of condensation is the same at different temperatures, although the evidence, so far as it goes, appears at present to point in that direction. Comparing the three different methods of experiment, which all lead to a similar result, it may be regarded as highly probable that the old view of an infinite rate of condensation requires revision, and that the value of the rate of condensation of steam on a metal surface, as determined by the author's previous experiments, is at least a first approximation to the truth. The question at issue is one of fundamental importance in the theory of the steam engine, and the authors have shown in the paper already quoted that, if the law of condensation there proposed be admitted, a number of interesting practical deductions can be made, and problems may be solved which have not hitherto been regarded as amenable to other than empirical treatment.

THE JONES' UNDERFEED MECHANICAL STOKER.

It is over 100 years ago since the first mechanical stoker was made. In 1785 James Watt patented a device for pushing the coal from the front end of the grate, after it was coked towards the bridge wall. It was worked by levers and the prime object was to prevent smoke when using bituminous screenings. Since then the best inventive genius in the world has been striving to perfect a smokeless furnace.

The number of smoke prevention devices which have been invented is legion, and the number of failures also legion. Among those of the present day for which considerable merit can be claimed is the Jones' Underfeed Mechanical Stoker, which is said to be a truly smokeless and economical device, and one which meets the demand for economy which is now

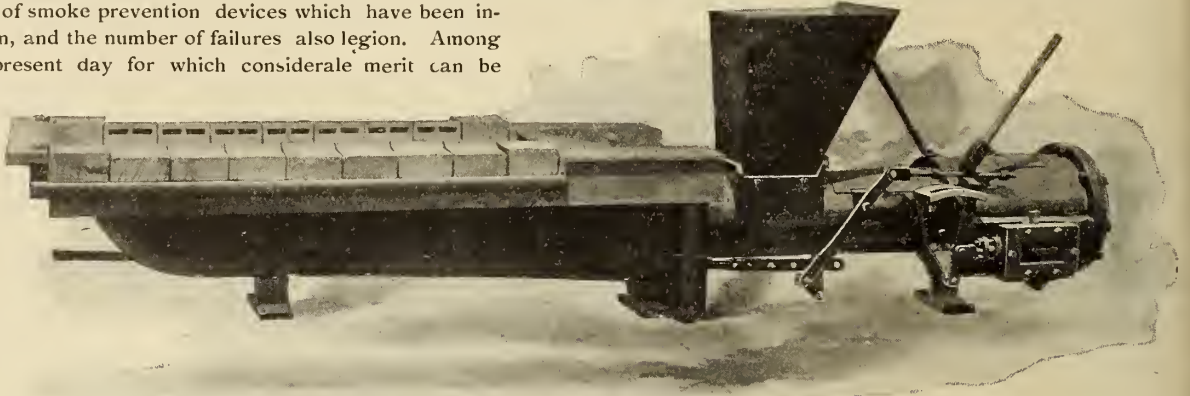
so essential in all power plants where steam is used. To give our readers a better understanding of this invention we give some illustrations herewith, as well as some particulars of its construction, operation and application.

The stoker consists of a steam cylinder or ram, with hopper for holding the coal, outside the furnace proper, and a retort or fuel magazine, inside the furnace, into which the green fuel is forced by means of the ram; Tuyere blocks, for the admission of air, being placed on either side thereof; the retort containing at its lowest point, and at a point where the fire never reaches, an auxiliary ram or pusher by means of which an even distribution of the coal is obtained.

By means of the rams coal is forced underneath the fire, each charge of fuel raising the preceding charge upward, until it

furnace is being fired without steam in the boiler. The retort is first filled with coal, level, or a little above the tuyere blocks. Fire is then started by placing kindling or greasy waste, lighted, along each side of the retort and opening wide the air chamber reaching to the tuyere blocks. As soon as sufficient steam is raised to run the blower, air chamber opening is closed, blower is used for furnishing air, and fire will be built up very rapidly.

Coal being in the hopper, and the ram plunger at its forward



IMPROVED JONES' UNDERFEED MECHANICAL STOKER.

stroke, when more coal is needed the ram plunger is shifted by moving the lever; coal then falls in front of plunger and upon return movement is forced into the retort, this movement being repeated until sufficient fuel is in the retort. After fire is properly started, never make more than two charges of the ram at a time, as by so doing green coal is forced into the fire, which will produce imperfect combustion and consequently smoke.

Air, at low pressure, being admitted into the air chamber and through the tuyere blocks, over the top of the green fuel in the retort, but under and through the burning fuel, the result is that the heat from the burning fuel over the retort slowly liberates the gas from the green fuel in the retort. This gas being thoroughly mixed with the incoming air before it passes through the burning fuel above, results in a bright clear fire, free from smoke, and the

complete consumption of all the heat-producing elements in the fuel. The retort being air tight from below, and the fuel being in a compact mass in the retort, the air will find its way in the direction of the least resistance, which is upward, consequently combustion takes place only above the air slots, hence the castings of the retort are always cool and not subject to the action of the fire. The incoming fresh fuel from the retort forces the resulting ash and clinker over the top of the tuyere blocks on to the side plates, from whence they may be removed at any time without in the least interfering with the fire in the centre of the furnace, resulting in a high, even temperature at all times.

To secure the best results a heavy body of coke should at all times be carried in the furnace, as nearly like the illustration as possible. The amount of coal consumed is regulated entirely by the quantity of air forced in the furnace, so that

when little steam is needed the quantity should be reduced.

The Jones' stoker may be applied to practically all types of boilers. It will also burn any kind of bituminous or lignite, slack or screenings, with a substantially smokeless stack. The manufacturers claim that competitive tests have shown a difference between the stoker and ordinary hand firing of from 20 to 35 per cent. in favor of the stoker.

Another advantage claimed for the device is that it removes the necessity of high chimneys, and is therefore economical. To illustrate, let us consider the difference in cost between two power



TERAULEY STREET STATION, TORONTO ELECTRIC LIGHT CO.

reaches the fire, which point it does not reach until it has been coked, when in its coked state it is forced upward into the fire. The gases being liberated under the fire, and at that point mixed with air, must necessarily pass through the fire and be consumed, thus giving the benefit of all combustible matter in the fuel.

Air is forced, at a low pressure, through the Tuyere blocks, under the burning fuel, by means of a blower, operated by an independent engine, or from a line shaft, if such arrangement can be made.

As to the operation of the stoker: We will suppose that the

plants, say of 2,000 h. p., one with high chimney, natural draft, and plain furnaces, and the other fitted with the Jones' Underfeed Mechanical Stokers. The cost of the first plant, exclusive of the building, would be approximately (ten boilers, including setting, \$36,000, and the chimney, say 100 feet high by 7 in diameter) \$40,500. In the second plant it is necessary to put in only eight boilers to get the same results as far as power is concerned, leav-

to over \$3,000 yearly. We have, therefore, a saving in first cost of \$4,700, and a yearly saving of over \$3,000.

Engineers and others who wish to learn more of this invention should address the manufacturers, the General Engineering Company of Ontario, Limited, 80 Canada Life Building, Toronto. They have recently issued a hand-book descriptive of the stoker, in which are also found many valuable tables and other useful data.

SPARKS.

A. McDonald, electrician, New Denver, B. C., is reported to have gone out of business.

The incorporation is announced of the Rotary Engine Company, of Woodstock, Ont., with a capital of \$24,000.

The Hull Electric Co. are building a 400 foot water chute at Aylmer Park, which it is expected will prove a great attraction during the summer months.

The Chateau Frontenac Hotel in Quebec is now heated by four Babcock and Wilcox boilers, which have been installed in the new wing recently completed.

The city council of Halifax, N. S., is now discussing the question of installing a municipal electric light plant. The matter has been referred to the electrician for a report.

The Dawson City Electric Co. is applying for incorporation to supply electric light, heat and power throughout the city and within a radius of 200 miles, as well as to operate an electric tramway.

The Canadian General Electric Company have closed the contract with the Laurentide Pulp Company, at Grand Mere, Que., for two 55 kilowatt moderate speed current dynamos, with marble panels and instruments complete.

A special meeting of the Merchant's Telephone Company was held in Montreal last month, at which it was announced that the company had obtained authority to increase its capital to \$1,000,000. The annual meeting will be held on the second Thursday in April.

The London Electric Company are increasing the generating capacity of their station to meet the large demands for light and power, and have placed an order with the Canadian General Electric Company for one of their standard 300 kilowatt single phase alternators and two 160 K. W. direct-connected power generators of their latest type.

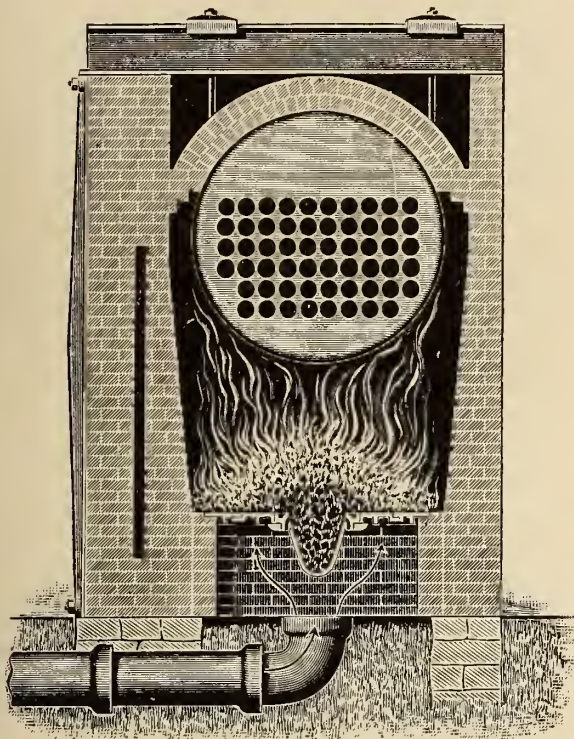
The Montreal Cotton Company, of Valleyfield, Que., have just placed an order with the Canadian General Electric Company for two 600 H. P. three phase generators, to be direct-connected to turbines. This installation is a duplicate of the generators installed by the Canadian General Electric Company over a year ago. With these four generators and station apparatus the company will have one of the most modern power stations on this continent.

The Hull Electric Company is suing the Ottawa Electric Co. for damages and infringements of the charter granted by the city council of Hull in 1894, by which the Hull company were granted the exclusive privilege for electric lighting. The Ottawa company contend that their right to erect poles within the city of Hull, for lighting purposes, was expressly guaranteed to them by a by-law passed by the city council six years previous to the Hull company's charter. The case is being bitterly fought.

At the annual meeting of the Lachine Rapids Hydraulic & Land Co., held in Montreal recently, the financial statement for the year ending December 31, 1897, showed that in the last two months sufficient revenue had been earned to pay the interest of 6% on the six months bonds. Over 1,000 customers were on the line, and in the neighborhood of 25,000 lights had been installed. It was announced that a five years' contract had been signed with the Imperial Light & Power Company, by which power for lighting, etc., would be supplied by the Lachine Company, and used for lighting the east end. A contract had also been signed with the Standard Light & Power Co., to supply them with power for straight current purposes, and, in turn, the Standard Company had acquired the entire plant, franchise and business of the Temple Electric Co., and would take possession on May 1st.

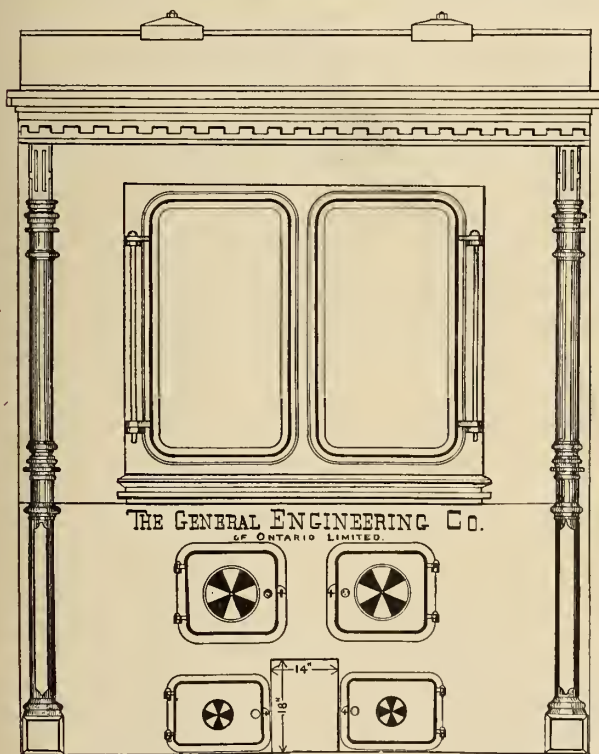
The telegraph line to be built by the C.P.R. between Montreal and Vancouver, referred to in a recent issue, will cost \$250,000. The wire to be used will be of copper, 300 lbs. to the mile, and will weigh about 450 tons. It is being manufactured by the Dominion Wire Manufacturing Co., of Lachine, Que., and will be tested at McGill University under the direction of the officers of the company. Mr. Jas. Kent, the Montreal superintendent of the company, gives some interesting details regarding the construction of the line. The short pieces of wire which will be used to tie the telegraph wires to the insulators will have a total weight of 6½ tons. Allowing two inches slack between each pole, owing to it being impossible to draw a line perfectly straight, will add four miles of wire to the line between Montreal and Vancouver. Leaving a small bundle of wire with each lineman for repairs will use up 20 miles of wire. The joints, which it is necessary to make at the end of each bundle, will require one mile of wire.

Mr. H. R. Leyden, manager of the Cataract Power Co., has made a proposition to pump the water supply of the city of Hamilton, Ont., by electric power. He agrees to erect at the head pumping house electric motors and revolving screw pumps of sufficient capacity to pump 10,000,000 gallons per day, and to erect at the high level pumping house motors and pumps and supply sufficient power to pump from the mains to the high level reservoir 2500 gallons per day. The company will keep the pumps in operation for one month, when the city will be expected, if satisfactory, to pay for them at the ascertained cost, not to exceed \$25,000. The price to be paid by the city for electric current necessary for pumping the water required is placed at \$13,000 per year for the first 1,600,000,000 gallons pumped in both reservoirs, and 6c cents for each additional 100,000 gallons. The company claims that its offer will meet the requirements of the fire underwriters and save the city more than \$20,000 per year.



CROSS SECTION SHOWING FURNACE IN OPERATION.

ing out of the question for the present the increased efficiency, and a short stack of from twenty to thirty feet high being sufficient. The cost of the eight boilers, including the setting, would be \$28,800, and this, together with the stokers and the chimney, makes a total of \$35,800, or a saving in the first cost of \$4,700, which is more than the cost of the chimney. There is also a reduction in boiler repairs, interest, taxes, etc. We come next to



SIZE OF OPENING IN BOILER FRONT TO RECEIVE THE JONES' STOKER.

the saving of coal. Taking the plant as above specified, ten boilers burning say 400 pounds per hour each, amounting to twenty tons per day of ten hours, with hand firing, against eight boilers burning the same quantity per boiler per hour for the same results=sixteen tons daily, or a daily saving of four tons, equal

EDUCATIONAL DEPARTMENT

INTRODUCTORY

After mature deliberation the publisher of this journal has decided to devote a certain amount of space each month to what may be termed an Educational Department, wherein both mechanical and electrical formula and mathematical problems will be discussed, illustrated, and as far as possible rule and example given. At the request of the editor, I have with pleasure undertaken to contribute to this department regularly each month, and before discussing actual mathematical problems, wish to briefly introduce the subject at issue.

The primary object of this department is chiefly to increase the value of an already valuable paper, by placing in the hands of every engineer who has any knowledge of the rudimentary principles of mathematics, such matter as will enable him by a little study to master the most intricate mechanical and electrical formula. Many of our most valuable engineering works and publications from time to time contain formula that is in many cases but vaguely understood, and very often entirely misunderstood, thus rendering an otherwise valuable work practically valueless to the reader.

Just at what particular point our calculations should commence became a matter of serious thought, and past experience had to be carefully considered, bearing in mind the fact that there are many really good engineers whose early education has, through force of circumstances, been deficient, and many others who, through lack of opportunity, have not been able to review their early education for years. Knowing by observation and experience the great necessity of having a thorough elementary education before attempting to digest and calculate problems, and the almost utter impossibility of the student arriving at a satisfactory conclusion of his studies without a thorough knowledge of the principle of mathematics involved, I have decided to commence at a point and carry out the programme outlined in this journal—commencing at the foundation and advancing by easy stages until the principles underlying the most obtuse and difficult formula can be readily explained and easily understood. The advantages to be derived from an education of this kind, coupled with practical mechanical ability, is too well understood to require comment.

The programme which has been outlined for the succeeding nine months will embrace:

DECIMAL FRACTIONS—Definitions and explanation of principles of, and method of reduction to common fractions, and vice versa.

SQUARE AND CIRCULAR MEASURE—Definition and explanation and practical demonstrations of.

CUBICAL AND CYLINDRICAL MEASUREMENTS—Definitions and explanations of, with practical hints.

SQUARE AND CUBE ROOT—Definitions and explanations of.

SAFETY VALVE CALCULATIONS—(Spring and Lever Types)—Principles of, with practical demonstrations.

BOILER CONSTRUCTION—Stays, rivets, joints and seams, iron and steel plate—strength of, with formula and practical demonstrations.

It is not the intention to fill these columns with a mass of figures hastily compiled without reference to any particular object; on the contrary, every problem will be carefully thought out, and only such information given as will be of use to you, and an effort will be made, based on experience and a knowledge of the requirements, to make his series of tests complete in every particular.

WM. THOMPSON.

[ARTICLE XII.]

REQUIRED SIZE OF LEADS IN CIRCULAR MILS.

A MIL is $\frac{1}{1000}$ of an inch, and written decimally .001. The area of a circle $\frac{1}{1000}$ of an inch in diameter is termed a circular mil, and a great many wire tables express the area of the cross section of a wire in circular mils written symbolically C. M. Rules for the sizes of wires as met with in engineering practice for given resistances are often based on circular mils, and include a constant for the conductivity of material of which wire is composed. From this, then, we can construct a formula for the calculation of the resistance of wire of whatever material composed, so long as we know the specific resistance of the material.

Commercial copper wire of 90% purity, one foot long and one C. M. in cross section, is said to have a resistance of 10.79 ohms at 75° F. (approximate). In accordance with the rule that the resistance of a circular conductor varies inversely with the square of its diameter and directly with its length, we can construct the following well-known formula for the determination of resistance of copper wire:

$$R = \frac{10.79 \times L}{d^2}$$

Example (10): A commercial copper wire one-half an inch in diameter has a specific resistance of 10.79, what is the resistance per foot?

$$\frac{1}{2} \text{ inch} = .500 \text{ mils.}$$

$$.500^2 = .250,000.$$

$$10.79 \div .250,000 = .000043 \text{ ohms per foot.}$$

Example (11): A copper wire 5,000 feet long, with a cross section of 8,000 C.M., what is its resistance?

$$\frac{10.79 \times 5,000}{8,000} = 6.743 \text{ ohms.}$$

The required cross section of a wire in C. M. is equal to its length divided by its resistance and multiplied by 10.79, or

$$\text{C.M.} = \frac{L}{R} \times 10.79$$

The required cross section of a pair of leads in C.M. for a given drop is found to be equal to the product of the length of leads multiplied by number of lamps (in parallel) by 21.58 by 100, minus the percentage of drop, and the whole divided by the resistance of one lamp hot multiplied by the percentage of drop allowed.

$$\text{C.M. or } d^2 = \frac{L \times 21.58 \times N \times 100 - \%}{R \times \%}$$

or what is the same thing,

$$\text{C.M.} = \frac{10.79 \times 2 \times L \times N}{R} \times \frac{100 - \%}{\%}$$

Example (12): Ten lamps are to be placed in multiple at the end of a double lead 100 feet long. The resistance of each lamp when hot being 220 ohms, what must be the sectional area of the wire if a drop of 5% is allowed on E.M.F.?

$$\frac{21.58 \times 100 \times 10}{220} = 98 \times \frac{100 - 5}{5} = 1872 \text{ C.M.}$$

Based on this and following out the principles laid down in Ohm's Law, the following formula is often given as a ready means of determining the required size of wire for house or secondary incandescent circuits:

$$\text{C.M.} = \frac{21.58 \times L \times N \times C}{L_v}$$

Where C.M. = Area in circular mils.

" L = Length of one side of lead.

" N = Number of lamps.

" C = Current required by each lamp.

" L_v = Number of volts per lamp loss in line.

When lamps or groups of lamps or other appliances are placed at different distances from the generator, apply principles laid down in example; or, roughly stated, determine first the size of wire required for each lamp or group, as if on independent circuits, starting from the dynamo, then combine all wires running in same direction.

DETERMINATION OF THE MEAN PRESSURE THROUGHOUT THE STROKE WHEN USING STEAM EXPANSIVELY.

Considering recent advances in modern engineering and improved appliances at hand, an article on this subject is perhaps superfluous. There are, however, such important principles involved and such useful information obtainable, that the author feels justified in referring to the subject at short length. Since a large proportion of my readers are operating simple non-condensing engines, the author will deal particularly with this class, and the principles involved can then be readily applied to compound engines of any type.

The engines to which many of us were first introduced had what is styled a fixed "cut-off," which took effect at almost any point between start and finish of piston travel, according to the views the engineer held on the question of working steam expansively. And speed was controlled by means of a throttling device, arranged to reduce or raise the pressure against the piston as occasion required. This type in modern practice is nearly obsolete, and we have in its stead what is termed an automatic "cut-off" engine, arranged to take steam at beginning of stroke at full boiler pressure, and regulating its speed by means of a variable "cut-off"—that is, initial pressure against piston on admission remains constant and varies only as pressure on boiler varies;

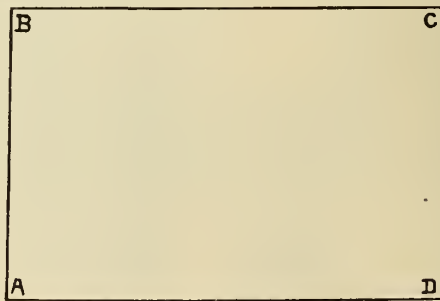


FIG. 5.

—and this pressure is maintained against the piston as it travels within the cylinder to a point of the stroke varying in direct proportion as the load on the engine varies.

Theoretically, then, if we had no cut-off until admission valve closed at the end of the stroke, the pressure of the steam against the piston would remain the same, and a diagram representing the operation could be drawn as represented in Fig. 5, within the letters, A, B, C, D, and the pressure against the piston can be readily ascertained by a simple process at any point of the stroke, and the mean, initial and terminal pressures would at all times be

equal, and the mean effective pressure would be initial pressure minus back pressure, and could be equally as readily determined.

Let us now suppose that when the piston has reached a point equal in distance to one-third of its travel, the admission valve closes and cut-off takes place; the piston then travels the remaining two-thirds of the distance by the expansive force of the steam already admitted, and supposing that expansion would take place under isothermal conditions, that is, that the temperature of steam remained constant, it is clear that as expansion increases pressure decreases, consequently the terminal pressure of the steam will be very much less than the initial pressure, and that at any point in the stroke between one-third and the end, the pressure will be less than the point immediately before and higher than the next succeeding point. If, then, we know the initial pressure of our steam and the point of cut-off, and can by any means determine the pressure at the respective points of the stroke, we can by finding the mean of these pressures thus determine the mean pressure on the piston. For this purpose, then, we re-arrange Fig. 5 as illustrated in Fig. 6, and divide this into

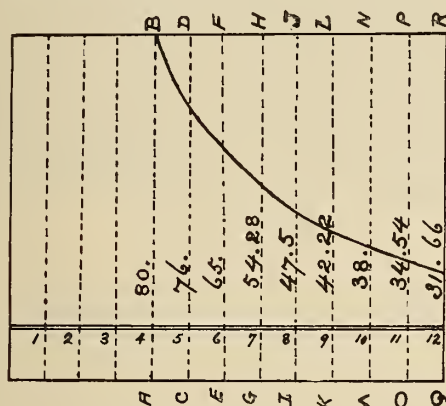


FIG. 6.

any even number of points, taking care that one of these points shall coincide exactly with and intersect point of cut-off.

To do this we first divide the cylinder into an equal number of parts by subtracting the numerator from the denominator of the point of cut-off expressed as a fraction, and if the result is an even number above six, the denominator of the fraction is the number of equal parts into which the cylinder can be divided so that one of the ordinates will exactly intersect the point of cut-off.

Example: With steam cut off at $\frac{1}{3}$ of the stroke, what number of parts must the cylinder be divided into?

As per rule, $15 - 3 = 12$ —an even number above six—therefore cylinder must be divided into 12 equal parts. It will, however, very frequently be found that when the numerator is subtracted from the denominator that either an odd number or an even number less than six is the result. In either case, double, treble or quadruple both the numerator and the denominator, and if this does not answer, increase fraction until you get a fraction giving the desired result.

Example: Suppose steam is cut off at $\frac{1}{3}$ stroke, into how many equal parts must cylinder be divided?

Proceeding as per rule, $3 - 1 = 2$, an even number less than six, which will not answer.

$\frac{1}{3} \times \frac{2}{2} = \frac{2}{6}$, which is still too low; we continue the process until we reach

$\frac{1}{3} \times \frac{4}{4} = \frac{4}{12} = 12 - 4 = 8$, an even number higher than 6, and cylinder can then be divided into 12 equal parts.

Fig. 6 then represents a cylinder, and we proceed to divide into 12 equal parts, with cut-off taking place at $\frac{1}{3}$ of the stroke. Each of the dotted ordinates in this diagram then represents the position of the piston expressed in $\frac{1}{12}$ ths of piston travel. Point of cut-off, or $\frac{1}{3}$ of stroke, will equal 4 of these parts, and the pressure of steam at 1st, 2nd, 3rd and 4th positions of piston remains constant.

When piston is in position, A, B, at 4, cut-off takes place, and at Q, R, exhaust valve opens. If steam then was expanding under true isothermal conditions, the lines, c, d, e, f, g, h, etc., show the gradual decreasing pressures of the steam due to expansion and pressures represented by letters, A, B, Q and R, show the total value of the steam during expansion.

To find the pressure of the steam at any one of the positions of the piston during expansion, multiply absolute initial pressure of steam by number of ordinate at point of cut-off, and divide this result by the number of ordinate at which pressure is desired.

Example: With steam admitted at 80 lbs. gauge pressure, find the pressure at each of the ordinates in diagram.

$80 + 15 = 95$, absolute pressure.

$95 \times 4 = 380$, value of steam previous to cut-off.

Then pressure at C D = $\frac{380}{6} = 63.33$ pounds.

" " " E F = $\frac{380}{8} = 47.5$ "

" " " G H = $\frac{380}{10} = 38$ "

" " " I J = $\frac{380}{12} = 31.66$ "

" " " K L = $\frac{380}{14} = 27.14$ "

" " " M N = $\frac{380}{16} = 23.75$ "

" " " O P = $\frac{380}{18} = 21.11$ "

" " " Q R = $\frac{380}{20} = 19$ "

To find total value of steam during expansion we require to find area of space enclosed by A, B, Q and R.

For this purpose we adopt the Simpson rule, which is: To the first and last ordinates add four times the sum of the even ordinates and twice the sum of the odd ordinates; one-third of this sum equals the area.

Then 4 or A B = 95 pounds.

5 or C D = 63.33 $\times 4 = 253.32$ "

6 or E F = 47.5 $\times 2 = 95$ "

7 or G H = 38 $\times 4 = 152$ "

8 or I J = 31.66 $\times 2 = 63.32$ "

9 or K L = 27.14 $\times 4 = 108.56$ "

10 or M N = 23.75 $\times 2 = 47.5$ "

11 or O P = 21.11 $\times 4 = 84.44$ "

12 or Q R = 19 $\times 2 = 38$ "

3 | 1255.82

Value during expansion, 418.60 "

Before expansion, 380 pounds.

During " 418.60 "

Value during whole stroke, 798.60 "

If, now, we divide by number of ordinates used, we get mean pressure against the piston throughout the stroke.

$798.60 \div 12 = 66.55$ pounds.

If the engine piston was running against a perfect vacuum, then mean pressure throughout the stroke would be the mean effective pressure on which to calculate power developed by any engine in doing work, but this rarely, if ever, happens; therefore the absolute back pressure against the piston must be deducted, and we get

Mean pressure - back pressure = mean effective pressure.

Example: Find mean effective pressure on the piston of a non-condensing engine when mean pressure is 66 pounds per square inch and back pressure two pounds above the atmosphere.

$2 + 15 = 17$ pounds absolute back pressure, and $66 - 17 = 49$ pounds mean effective pressure of steam on piston.

When principles of calculation are understood, formula for calculation can be considerably shortened by use of logarithms.

1st. The hyperbolic logarithm of the ratio of cut-off increased by 1 and multiplied by terminal pressure equals mean pressure.

2nd. The hyperbolic logarithm of the ratio of cut-off increased by one and multiplied by initial pressure, and result divided by ratio of cut-off, equals mean pressure.

3rd. Second rule minus absolute back pressure equals mean effective pressure throughout the stroke.

Example of Rule 1: Cut-off takes place at $\frac{1}{3}$ of stroke; the ratio of cut-off therefore is $3 \div 1 = 3$, and the hyperbolic logarithm of 3 is 1.09861,

$\therefore 1.09861 + 1 \times 31.6 = 66.39$ pounds, mean pressure.

Example of Rules 2 and 3:

$95 \times \frac{1.09861 + 1}{3} = 66.4$ pounds, mean pressure.

$95 \times \frac{1.09861 + 1}{3} - 17 = 49.4$ pounds, mean effective pressure (M.E.P.)

In addition to finding the mean pressure by process of calculation, we require also to find the mechanical efficiency gained by cutting off steam in comparison to steam being admitted during the whole of the stroke. This can be found by dividing the mean pressure by the terminal pressure absolute. Then $66.4 \div 31.6 = 2.098$; or expressed briefly, the mechanical efficiency is the hyperbolic logarithm of the ratio of cut-off plus 1.

Finally, on this subject, we want to find the co-efficient of efficiency or a number expressing the practical efficiency of the steam, including the effect of expansion as compared with the duty of the same steam without cut-off or expansion and loss by back pressure.

Rule:

$\frac{\text{Mean effective pressure} \times \text{Length of stroke}}{\text{Absolute pressure} \times (\text{Length of admission} + \text{Clearance})} = \text{The co-efficient of efficiency.}$

Example: Find the co-efficient: Gauge shows 80 pounds; stroke 12 inches, cut-off taking place at $\frac{1}{3}$ of stroke, and mean effective pressure is shown to be 49 pounds, piston having $\frac{1}{4}$ inch clearance.

$80 + 15 = 95$, absolute pressure.

$\therefore \frac{49 \times 12}{95 \times (4 + .25)} = \frac{588}{403.75} = 1.45$ co-efficient.

ELECTRIC RAILWAY DEPARTMENT.

DOVER MUNICIPAL ELECTRIC TRAMWAYS.

WE have been favored with a copy of a pamphlet containing an illustrated description of the Dover Municipal Electric Tramways, constructed by Messrs. Dick, Kerr & Company. It will be remembered that about one year ago Mr. J. A. Rutherford resigned his position as chief engineer of the Canadian General Electric Company to accept the management of the electric traction department of this well-known engineering firm.

The city of Dover was one of the first in England to adopt electric tramways on the overhead wire system. The pamphlet states that when, early in 1896, the Council was considering the question of railway construction, a comparison of the capital cost of building tramways for gas and electric traction was given as follows:

	Gas.	Electricity.
Cars (capacity 40 passengers).....	£5,600	£ 4,620
Trailers.....	660	660
Machinery.....	1,750	.....
Line equipment.....	.....	7,500
	£8,010	£12,780

For working the respective systems offers were made of 6½d. per car mile for gas, and 6d. for electricity, the latter to be reduced to 4½d. if the mileage exceeded 240,000 car miles per annum. The saving of a half penny per car mile, it was considered, would much more than pay the interest on the larger capital required for construction.

The road was constructed during the fall of 1896 and following spring and summer. The rails used are of the girder type, weighing 87 lbs. per yard, and are 30 ft. long and 6 in. deep. The gauge of the tramway is 3 ft. 6 in., which was determined by the extraordinary deference of the framers of the Tramways Act of 1890. With the exception of a short distance the tramway is single track. The conducting system is of the usual character.

Owing to the shortness of the line, it being only about 3½ miles, no feeders were provided. The current is distributed from a central switch pillar, about 4 feet high, of cast iron, and divided internally into two chambers. The rolling stock consists of eight motor cars and two trail cars. Power is obtained from the Dover Electric Supply Company. The fare charged is only one penny.

ELECTRIC RAILWAYS AND BICYCLES.

MAJOR I. B. Brown, in making his annual report on the street railways of Pennsylvania, states that the receipts of the state street railways have considerably fallen off within the past twelve months. He regards the use of the bicycle by both business people and pleasure seekers as the main source of the reduction in the traffic of many street railway companies. He finds that in cities where the hills are steep and less favorable conditions for bicycle riding exist, the railway companies have not been affected by it to the same extent, but in many places it cannot be gainsaid that the bicycle has become a most formidable competitor of the street railway. In order to secure substantial confirmation of this view an observation was made in a leading street of Harrisburg about two months ago. The observation covered two days, from 7 o'clock in the morning to 6 in the evening. During that time 6,078 persons passed a given point, 1,962 in the cars and 4,116 on bicycles, i.e., 67.7 per cent. on bicycles and 32.3 per cent. on the cars, or more than two to one in favor of the wheel. The figures secured at Harrisburg are by no means exceptional.

The Toronto Street Railway Co. purposes carrying out a number of extensions this season. It is probable that the line will be extended to Oakville, and also that the City and Suburban Electric Railway will be purchased and operated as a separate road, as is now done in the case of the Mimico branch. The City and Suburban Company have 12 miles of rail laid between Toronto Junction, Weston and Lambton.

TORONTO RAILWAY COMPANY'S ASSESSMENT CASE.

THE long-standing litigation over the assessment of the poles, wires and tracks of the Toronto Railway Company was settled last month by the Court of Appeal, judgment being given in favor of the city.

When the city made the assessment on Ward 1 last year, the company appealed to the Court of Revision, which sustained the assessment. Then the company appealed and brought the matter before a bench of three judges, composed of Judge McDougall, County Judge of York, and the senior judges of the adjoining counties, Dartnell, of Ontario, and McGibbon, of Peel, who decided in favor of the company, Judge McDougall dissenting. In the meantime the Assessment Department went on and assessed the poles, wires, etc., of the company in the other wards of the city, and in each case the company appealed to the Court of Revision against the assessment, the Court of Revision, in view of the judgment of the three judges in the case of Ward 1, sustaining the appeal of the company. This placed the city in the position of being the appellant against the decision of the Court of Revision, and an appeal was taken to Judge McDougall, it being deemed unnecessary to call in the other two judges in this instance. Judge McDougall, after hearing argument, reversed the decision of the Court of Revision and held that the company was liable for assessment. Then the company appealed from this decision to the Court of Appeal, with the above result.

By the decision the assessment of \$452,277 against the company in Wards 2 to 6 is confirmed for 1898, which will probably yield between \$7,000 and \$8,000 in taxes. Next year a further addition to this assessment of about \$85,000 for the First Ward will be made, making a total assessment of about \$540,000.

SPARKS.

The International Radial Railway Co. will apply to parliament for an extension of time for the completion of its line to Guelph.

The Halifax Electric Tramway Company will spend about \$50,000 in improving their plant. They have just installed two large generators.

Lowe & Farrell, of Hamilton, have been given the contract for stringing the power wire from Decew Falls to Hamilton, for the Cataract Power Company.

Messrs. Peters, Peters & Ings, on behalf of the local gas company, have made a proposition to the city to build a street car system in Charlottetown, P.E.I.

It is reported that Messrs. A. Tremblay & Frere, of Herbertville, Que., have purchased property at St. Alphonse with a view of constructing an electric railway there.

The Smith's Falls, Rideau and Southern Electric Railway Company applied at a recent meeting of the Smith's Falls council for permission to lay rails and erect poles in that town.

E. F. Hutchings, of Winnipeg, and others, ask power from the legislature to construct an electric or steam railway from Winnipeg along the east side of Red river to St. Andrew's rapids.

At the annual meeting of the Sandwich, Windsor and Amherstburg Electric Railway Company, the statement of receipts presented showed a marked increase over those of the previous year.

A by-law has been given its first reading in the St. Catharines city council authorizing the construction of an electric railway between that city and Port Dalhousie. Mr. H. C. Symmes is interested.

The projectors of the Hamilton, Chedoke and Ancaster Electric Railway Company state that the line will be built from Hamilton to Brantford, providing the city council buys the Mountain Drive for \$12,000.

H. Abbott, of Vancouver, William Whyte, of Winnipeg, and others, have petitioned the provincial legislature for the incorporation of the Mountain Tramway and Electric Company, to construct an electric railway.

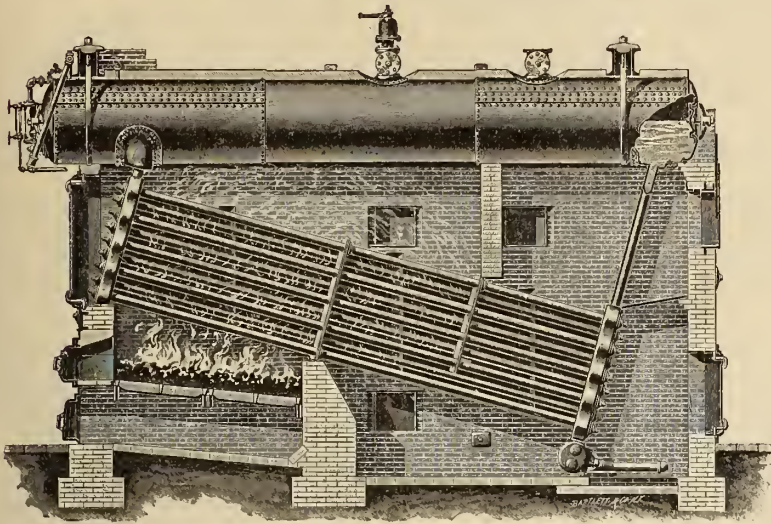
The Halifax Chronicle says that the electric tramway scheme from Halifax to Bedford, N.S., has been killed, so far as the Halifax and Bedford company is concerned. Their charter has been amended so as to enable them to build a tramway only from Three Mile House to Bedford, and to supply electric lighting between the same two points.

The Council of Peterboro', Ont., again discussed at a recent meeting the proposed extension of the electric railway to Chemong and Lakefield. The promoter of this road is Mr. D. A. Starr, of Cornwall, who estimates the cost at \$350,000. The council resolved to submit a by-law to the ratepayers to guarantee interest on one-third of the company's expenditure for 10 years at 5 per cent., the sum guaranteed not to exceed \$100,000.

By an agreement entered into upon the commencement of the road, Mr. J. H. Beemer had a two years' option for the purchase of the Quebec Street Railway. It is now said to be his intention to purchase the road, and to consolidate it with the Quebec, Montmorency and Charlevoix Railway. The motive power of the latter road will at once be converted from steam to electricity. Later on the extension of the Quebec, Montmorency and Charlevoix will be made to Murray Bay.

Mr. A. H. St. Germain gives some particulars of the proposed auto-car service to be established this summer between Toronto and Richmond Hill. The initial car will be a passenger and parcel van, capable of receiving 25 passengers. It will be fitted with electric light and buttons for use of conductor and passengers, by which warning may be given the motorman to turn to the right or left. Mr. Germain claims that the car will develop sufficient power to ascend the heavy grades between Toronto and Richmond Hill, at a speed varying from 6 to 12 miles per hour, carrying a full complement of passengers. The electrical equipment is the invention of Mr. W. J. Still, mechanical engineer.

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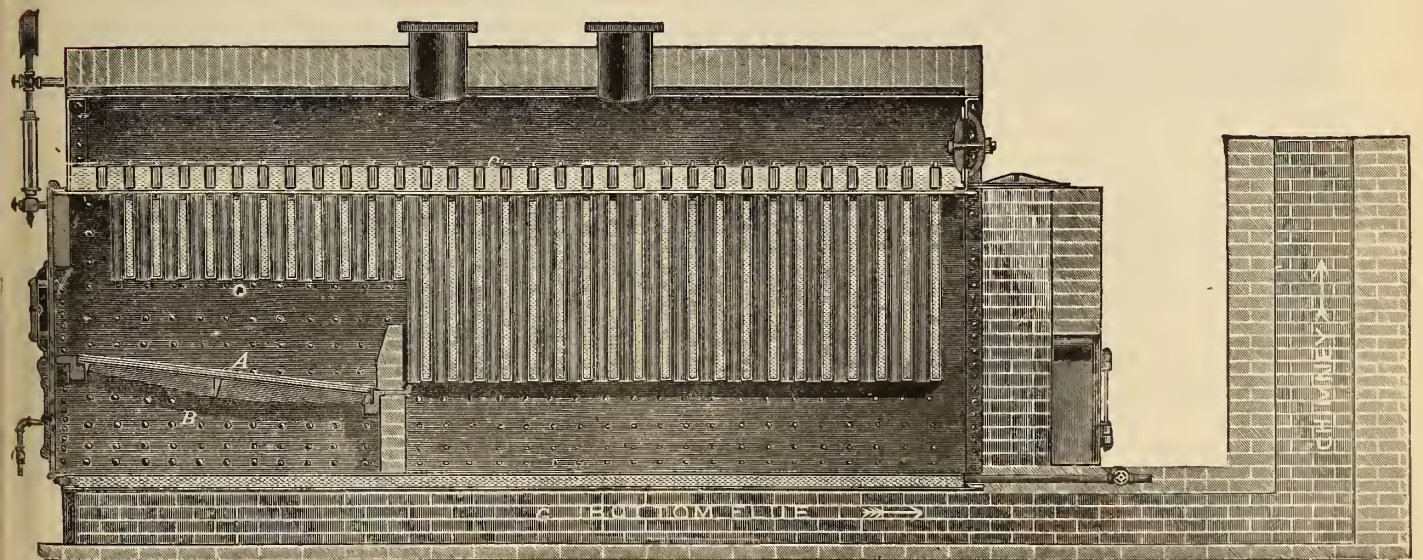
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TRADE NOTES.

! The Perth Water Works Co. is installing two-phase "S.K.C." motors.

A. Gagnon, Victoriaville, Que., are adding one of the Jenckes Machine Co.'s standard boilers to their equipment.

Henry Morgan & Co., of Montreal, have placed an order with the Royal Electric Co. for a 20 K.W. direct current generator.

The Canadian General Electric Company have sold to Mr. Alex. Dobson, of Beaverton, one of their standard 20 k. w. Edison dynamos.

Messrs. Ness, McLaren & Bate, electrical supplies, have recently removed their factory and salesrooms to 419 St. James street, Montreal.

Larkin & Sangster, contractors, Iroquois, Ont., have purchased from the Canadian General Electric Company a 35 light arc dynamo, with lamps.

The Brantford Electric & Operating Co. is installing a 60 K.W. "S.K.C." and a 40 light T-H arc machine received from the Royal Electric Co.

The Canadian General Electric Company are furnishing to the Linde British Refrigerating Co., Montreal, two 50 h. p. and one 15 h. p. induction motors.

The Robb Engineering Co. has received an order for two Robb-Armstrong engines, 150 horse power each, for the electric railway at St. Thomas, Ont.

The Canadian General Electric Company have closed a contract with the corporation of Port Arthur for a railway car body equipped with G. E. 1000 motors.

Senator Poirier, of Shediac, N. B., has placed an order with the Robb Engineering Co. for a 60 horse power engine and boiler for running his flour and shingle mills.

The Canadian Pacific Navigation Co., Victoria, B. C., have purchased from the Canadian General Electric Co., for one of their steamers, a multipolar direct connected sett, with marble switchboard.

W. J. Fletcher, of Markham, proprietor of the electric light plant there which was recently destroyed by fire, has decided to reconstruct the plant, and has purchased from the Royal Electric Co. a 20 K.W. "S.K.C." generator.

The Canadian General Electric Company have recently closed a contract with the managers of the Longue Pointe asylum for one 110 k. w. multipolar railway generator and one freight motor car, equipped with G. E. 1000 motors.

The Kenneth Mining and Development Co., at Rossland, are making an addition to their equipment in the shape of a 7 x 10 double cylinder hoisting engine, with boiler and all appliances complete, supplied by the Jenckes Machine Co.

The American Hard Fibre Co., Newark, Delaware, announce that Mr. H. M. Grant, who has been travelling in the interest of the fibre trade for the past 18 years, has recently connected himself with that company.

The Shipton Electric Light and Power Co., of Danville, Que., have received a Crocker turbine from the Jenckes Machine Co., Sherbrooke, who are proceeding with the installation of the same, together with the penstock and draft tube.

The Peoples Electric Co., Windsor, Ont., are making extensions to their electric system, and have placed an order with the Canadian General Electric Company for all the material required, including over 1000 light capacity in transformers.

William McVicar, McVicar, Ont., is putting a Dake steam feed into his mill. This feed was built by the Jenckes Machine Co., Sherbrooke, with whom the Phelps Machine Co., Eastman, Que., formerly Canadian manufacturers of the Dake engine, have been amalgamated.

The Jenckes Machine Co., Sherbrooke, are furnishing the Canadian Rand Drill Company with a handsome compound Corliss air compressor, weighing some 33 tons, together with a large air receiver and other accompanying apparatus, bringing the total weight up to about 40 tons.

The Robb Engineering Company, of Amherst, N. S., recently completed a Robb-Armstrong compound engine for an electric installation in a European city; also three of the same type, 200 h.p. each, for another foreign order, and two of 225 h.p. each for the Rathbun Co., of Deseronto.

The Electric Reduction Co., Buckingham, Que., are proceeding to develop their water power, and as a first step have placed an order with the Jenckes Machine Co., Sherbrooke, Que., for a pair of their 45" Crocker turbines, to be installed complete, with wheel cases, draft tubes, governor, etc.

W. Doherty & Co., Clinton, Ont., have commenced work on their new factories, which they expect to have completed by May 1st. Their new works are to be lighted throughout by electricity, for which purpose they have closed a contract with the Canadian General Electric Company for a 500 light dynamo, two 10 h. p. motors and all wiring material required.

Mr. Thos. Proctor, superintendent electric light and water works, Fort William, Ont., in renewing his subscription to THE NEWS, writes: "I consider your paper indispensable to the electrical profession."

It is said that the St. Clair Tunnel Company contemplate converting the motive power for the tunnel from steam to electricity. The matter is understood to be under consideration by Mr. Jos. Hobson, chief engineer of the company, of Montreal.

PERSONAL.

Mr. J. Gibson, city electrician of Toronto, has recently undergone a severe illness.

The Light Commissioners of Fort William, Ont., have appointed Mr. Thos Proctor as electrician for the town.

Mr. J. H. Ward has resigned his position as electrician for the St. Marys Electric Light Company. His successor is Mr. A. Cahoun, of Mitchell.

Mr. Harry H. Denis has been appointed superintendent of the Hull Electric Co., to succeed Mr. Chas. Aird, who will probably go to British Columbia.

Mr. T. E. McLelan, manager of the Berlin and Waterloo Street Railway, has resigned his position. His successor is Mr. H. Hilburn, who has been connected for some time with the Montreal street railway.

The many friends of Mr. Chas. F. Ernst, formerly of New Hamburg, Ont., and who has represented the National Carbon Co. in Canada for many years, were pained to learn of his death shortly after the first of the year.

Mr. Henry Holgate, manager of the West Indian Electric Co., of Kingston, Jamaica, returned to Montreal last month on a business trip. He states that arrangements are being completed for building the new electric railway in Kingston, and that work will commence in April. He will shortly return to Jamaica.

It is with pleasure we announce the recovery of Mr. J. A. Kammerer, general agent of the Royal Electric Co., of whose serious illness mention was made in a recent number. On the first inst. Mr. Kammerer was able to leave for the Southern States, where we trust his hopes of rapidly regaining his old-time health and energy may be fully realized.

A NOVEL IDEA.

THE International Correspondence Schools, of Scranton, Pa., have had fitted up a handsome railway car, containing sleeping and other living accommodation, library, etc. It is the purpose that this car, manned by a staff of teachers and students, shall be located for a time in the vicinity of large manufacturing establishments and afford those interested a practical demonstration of the method by which the work of the schools is carried on.

MOONLIGHT SCHEDULE FOR MAY.

Day of Month.	Light.	Extinguish.	No. of Hours.
	H.M.	H.M.	H.M.
1....	A.M. 12.40	A.M. 4.00	3.20
2....	" 1.00	" 4.00	3.00
3....	No Light.	No Light.	.....
4....	No Light.	No Light.	.....
5....	No Light.	No Light.	.....
6....	No Light.	No Light.	.....
7....	P.M. 7.30	P.M. 10.30	3.00
8....	" 7.30	" 11.30	4.00
9....	" 7.30	A.M. 12.20	4.50
10....	" 7.30	" 1.00	5.30
11....	" 7.30	" 1.30	6.00
12....	" 7.30	" 2.00	6.30
13....	" 7.30	" 2.30	7.00
14....	" 7.30	" 3.00	7.30
15....	" 7.40	" 3.20	7.40
16....	" 7.40	" 3.40	8.00
17....	" 7.40	" 3.40	8.00
18....	" 7.40	" 3.40	8.00
19....	" 7.50	" 3.40	7.50
20....	" 7.50	" 3.40	7.50
21....	" 7.50	" 3.40	7.50
22....	" 8.30	" 3.40	7.10
23....	" 9.10	" 3.40	6.30
24....	" 9.50	" 3.40	5.50
25....	" 10.20	" 3.40	5.20
26....	" 10.50	" 3.40	4.50
27....	" 11.00	" 3.40	4.40
28....	" 11.10	" 3.40	4.30
29....	" 11.40	" 3.40	4.00
30....		" 3.40	3.00
31....	A.M. 12.40		

Total..... 151.40

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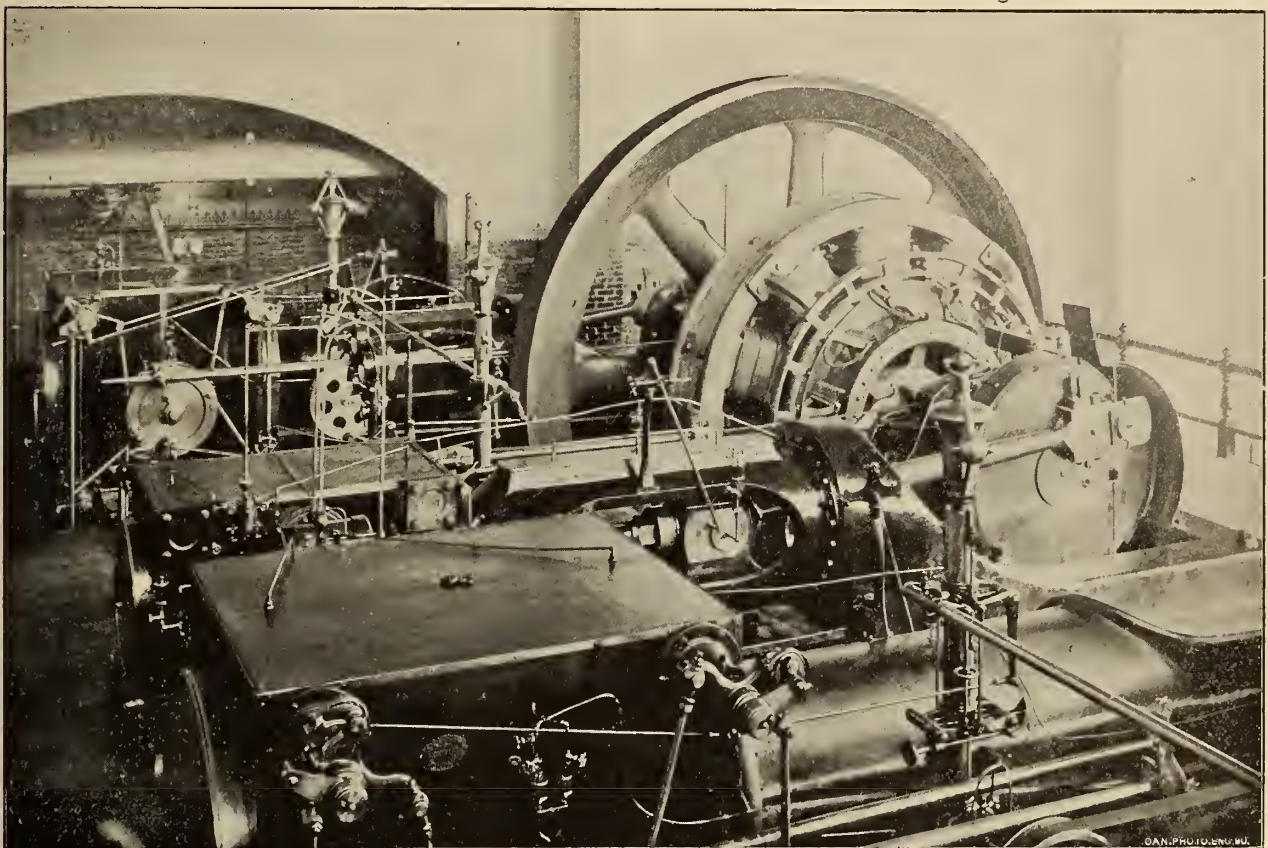
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SPARKS.

It is said to be the intention of the Kent Mills Company, of Chatham, Ont., to install new boilers.

The Bell Telephone Company recently made some improvements in their exchange at Huntsville, Ont.

The Montreal Street Railway Company is building twenty motor cars for the Kingston, Jamaica, street railway.

The city council of Victoria, B. C., recently invited tenders for another dynamo for the electric light plant.

The Northern Electric & Manufacturing Company has been granted a Dominion charter. Mr. C. F. Sise is president.

Ephraim Arnold, whose son was killed by an electric shock, has entered an action for \$2,000 damages against the Hull Electric Co.

The C. P. R. intend to erect a new station at McAdam Junction, N. B., and to install a private electric light for lighting the same.

A by-law will probably be voted on by the ratepayers of Toronto to provide \$40,000 for converting No. 2 engine at the waterworks plant to high duty, including boilers.

Mr. Spittal, of Dundas, Ont., is organizing a company having for its object the installation of an electric plant for lighting the streets of that town.

The town council of Pembroke, Ont., has appointed a committee to report on the cost of installing and maintaining an electric, gas or other lighting plant for the town.

D. Maxwell and Sons, St. Marys, Ont., are installing an electric plant for lighting their factories, and have purchased for the purpose a 350 light Edison dynamo, manufactured by the Canadian General Electric Company.

Messrs. Price Bros., of Quebec, have ordered from the Canadian General Electric Company a complete electric and steam plant for the Assiniboine block, Winnipeg, Man. The generating plant will have a capacity for 400 lamps.

Mr. W. H. Pearson, jr., of Toronto, has entered an action against Mayor Johnson, of Belleville, who at the last meeting of the city council charged Mr. Pearson with interfering to prevent the sale of the gas stock and electric railway to an English syndicate.

The St. Philemon Telephone Company has been incorporated, with a capital of \$1,500, to construct a telephone line in the counties of Bellechasse, Dorchester and Montmagny, Que. Among the promoters are Dr. Jos. Cote and Geo. A. Lamarre, of St. Valier.

The present contract with the Hamilton Light & Power Co., for lighting the streets of Hamilton, expires in less than two years. Alderman McAndrew has therefore moved in council that a committee be appointed to consider the advisability of establishing a municipal plant.

It is the purpose of the Metis Telephone Company, now seeking incorporation, with headquarters at St. Octave de Metis, Que., to build a telephone line in the counties of Matane and Rimouski. J. L. Pinault, advocate, of Quebec, and Thos. LeBel, of Fraserville, are interested.

The St. Thomas Gas Co. have ordered from E. Leonard & Sons, of London, three 100 horse power boilers, from Goldie & McCulloch, of Galt, an engine, and from the Northey Company a steam pump, to enable them to supply power for the electric railway.

The Canadian Electric Water Power Co., of Ottawa, are applying

for incorporation, with a capital of \$100,000. The purpose is to establish water works and manufacture electrical machinery, and the promoters are: Hon. John Haggart, W. A. Allan, A. Charlevoix, Sir Sanford Fleming, and R. G. Code.

The District Telegraph Company has been incorporated at Winnipeg, and asks the city for permission to string wires. The provisional directors are: Wm. Hespeler, John Galt, R. J. Campbell, Frank Drummond and F. W. Huebach. The company will expend a considerable sum of money in installing a plant.

The Canadian Developing Company, Victoria, B. C., are building three steamers to trade between Vancouver and Stikine river. These are to be equipped with the most modern systems of electric lighting, the company having placed an order with the Canadian General Electric Company for 3 direct-connected units to meet the requirements.

The Ottawa Electric Light Co. have been given the exclusive privilege of supplying light and power in the city of Ottawa, on the condition that the price of light be reduced 40 per cent. This is the result of an application made by the Deschenes Electric Light Company to be allowed to supply light and power to the citizens.

The Ontario Rolling Mill Company, Hamilton, Ont., are rapidly rebuilding their works recently destroyed by fire. They intend installing the most modern system of electric lighting throughout, and have placed an order with the Canadian General Electric Company for one of their latest types of multipolar direct current dynamos, having a capacity for 300 lights.

The Lachine Rapids Hydraulic & Land Co., of Montreal, have invited tenders for a new switchboard, to be placed in the sub-station at the corner of McCord and Seminary streets. They have also purchased two 150 k.w. synchronous motors, which will be used in the old Temple plant for the purpose of replacing the present steam plant and getting the power direct from the rapids.

The contract with the Lindsay Light, Heat & Power Co., for lighting the streets of that town, will expire in the near future, and the council is considering the question of installing a municipal plant. The Fire and Light Committee has recommended that a committee be appointed to report on the cost of the same, while the Mayor has been authorized to advertise for tenders for lighting.

The town of Parrsboro, N. S., recently completed its electric light plant, installed under the superintendence of Mr. George White-Fraser, of Toronto. The engines and boilers were supplied by the Robb Engineering Co., of Amherst; alternator by Munderloh & Co., Montreal; arc plant by Thompson Electric Co., Hamilton; transformers by W. A. Johnson Electric Co., Toronto; lamps by R. E. T. Pringle, Montreal; supplies by Canada General Electric Company, Toronto. Most of the apparatus were subjected to a thorough test and found satisfactory. The cost of the plant, which is the first to be installed by a municipality in the maritime provinces, was slightly less than \$11,000.

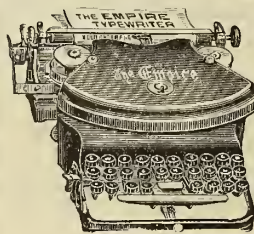
The Ingersoll Packing Company have contracted with the Canadian General Electric Company for a complete installation of incandescent lamps, arc lamps, motors and generator for their factories at Ingersoll, Ont. It is said that this contract was awarded after very mature consideration of the relative merits of two-phase alternating as against direct current machinery for isolated lighting and power service. The generating apparatus will consist of a 25 kilowatt 125 volt multipolar dynamo of the Canadian General Electric Company's latest and most approved type.

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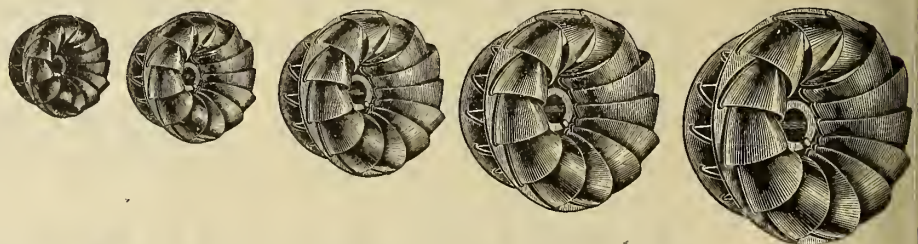
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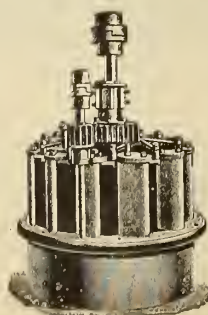
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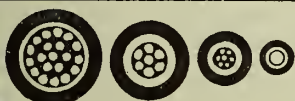
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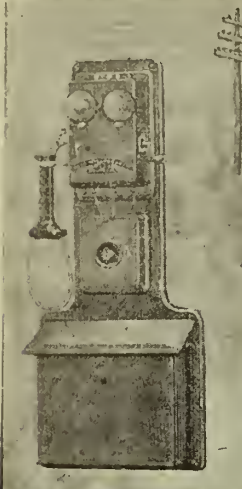
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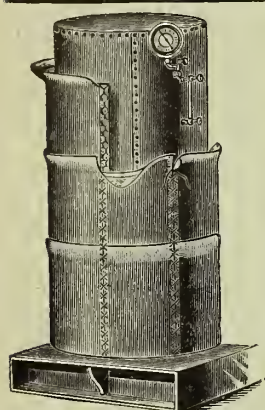
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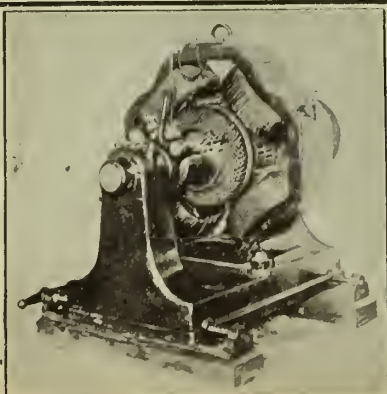
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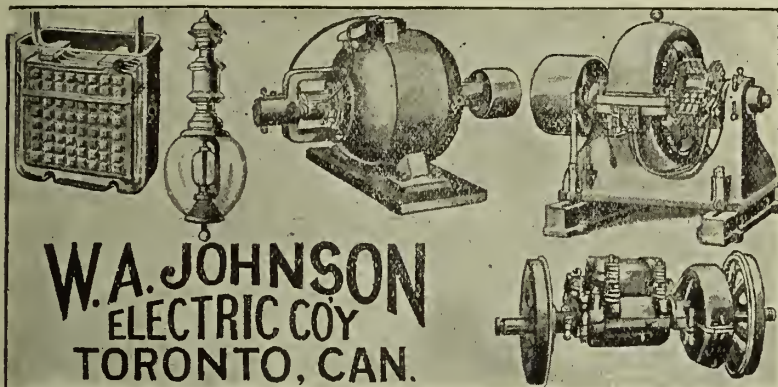
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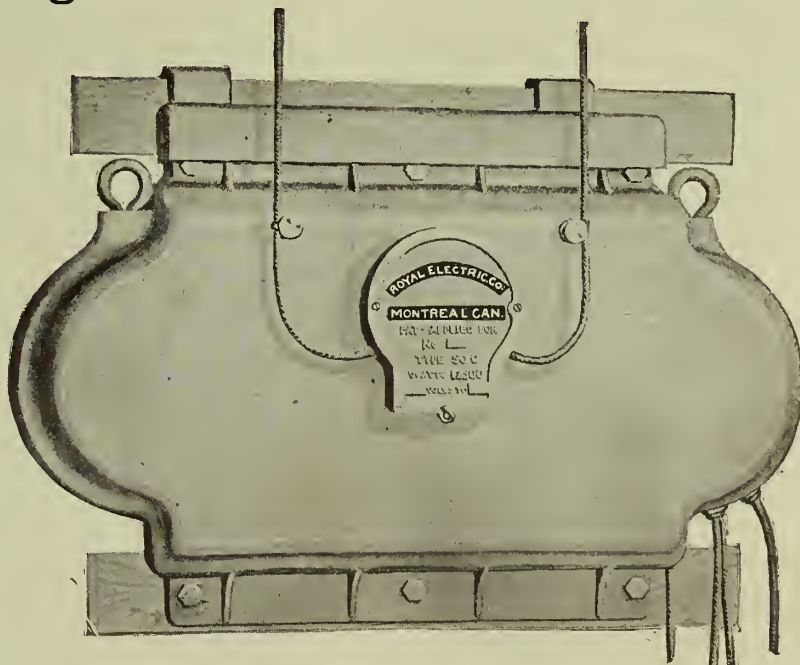
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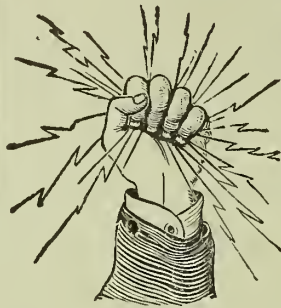
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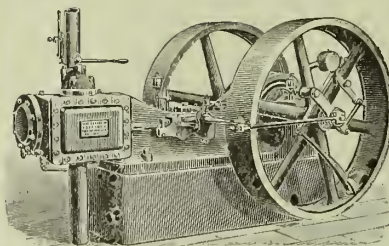
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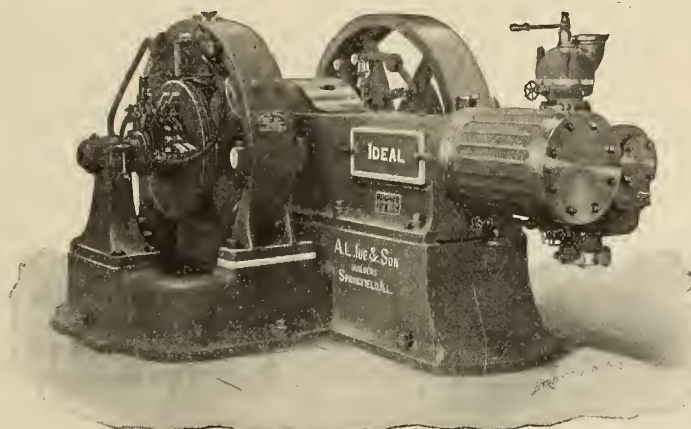
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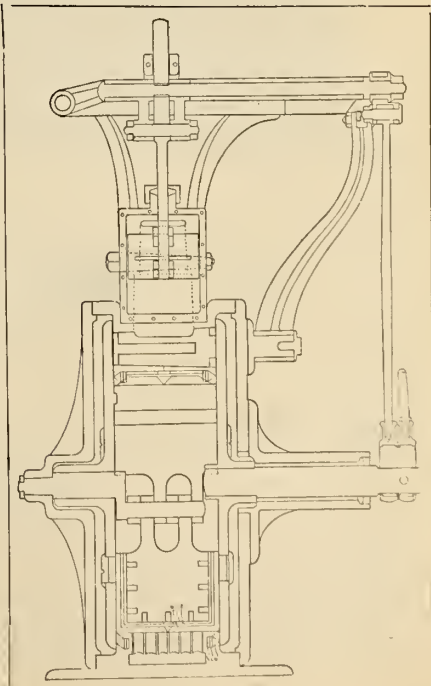
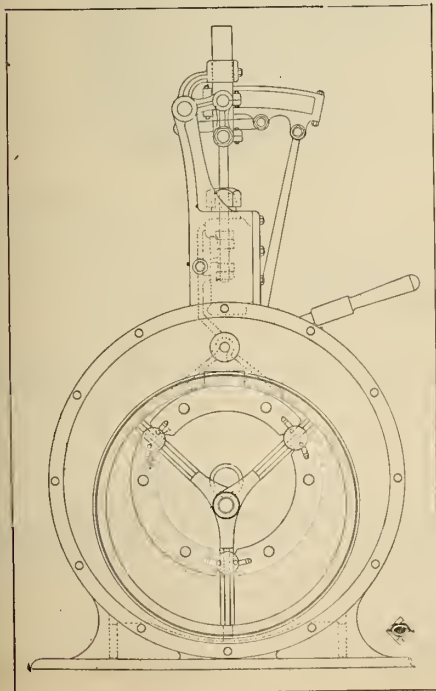
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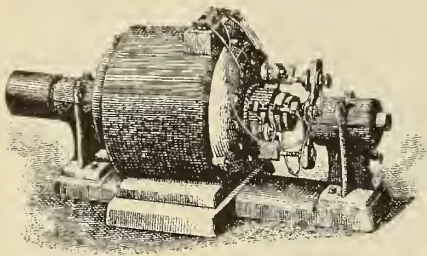


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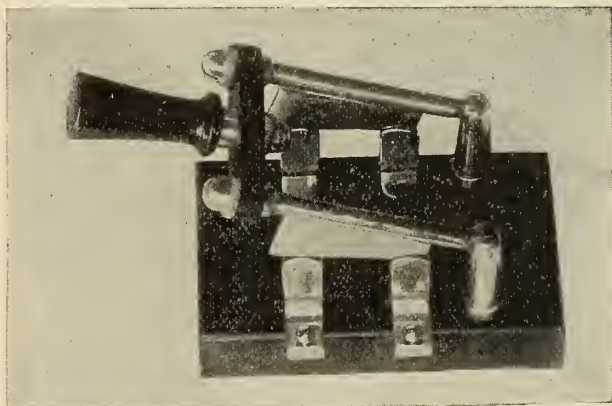
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Vol. VIII.

MAY, 1898

No. 5.

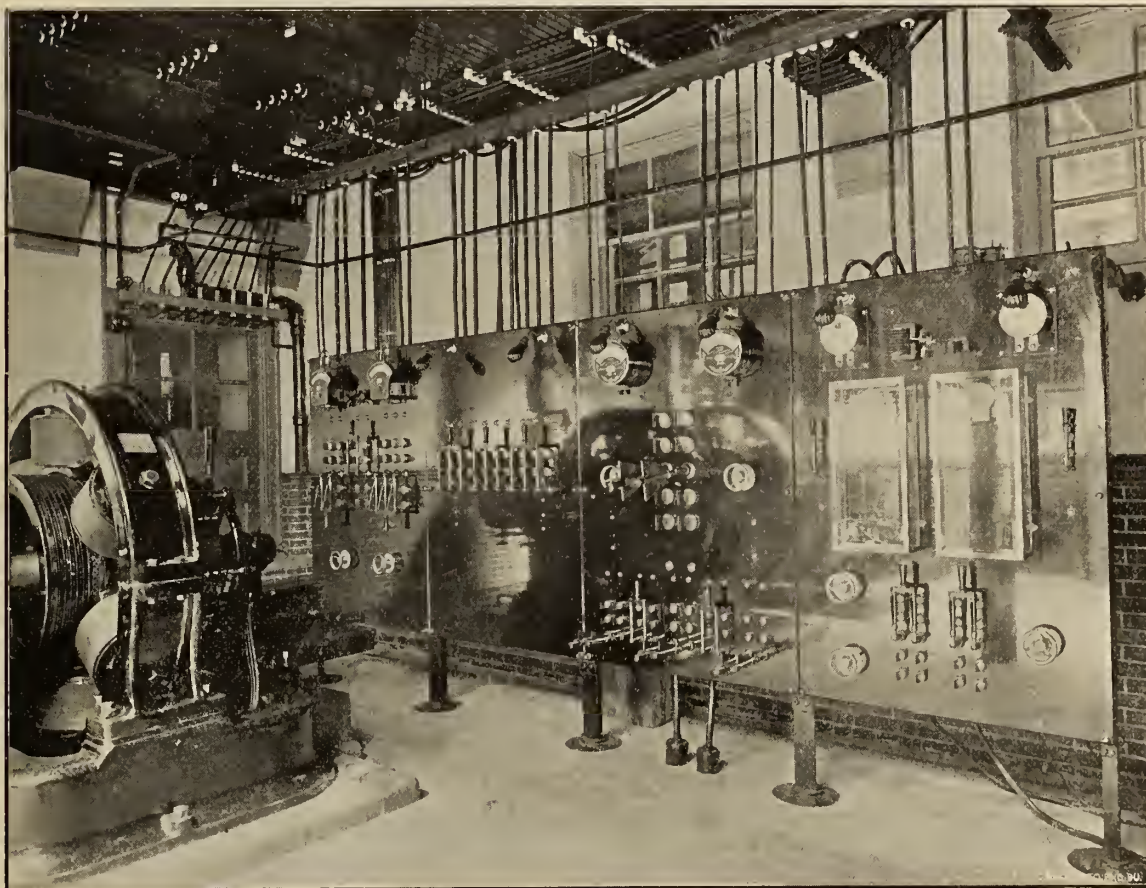
**ELECTRICAL PLANT OF MACDONALD
ENGINEERING BUILDING, MCGILL
UNIVERSITY, MONTREAL.**

THE lighting and power electric station of McGill University, Montreal, has, during the past year, undergone extensive enlargement and up-to-date alterations. The dynamo room is located in the basement floor of the Workman Technical Building, beside the boiler plant. The room is 36 ft. by 34 ft., with stone

motor generator (Lundell) is used as a booster for charging these batteries.

FOUNDATIONS.

The foundations for engines and generators are substantially constructed. The floor rests on bed rock, upon which is placed 18 inches of concrete, two ply of tar paper and asphalt, then again six inches of concrete, and one inch thick of Mosaic pavement. The foundations for the 75 k.w. generator



ELECTRICAL PLANT AT MCGILL UNIVERSITY.—VIEW OF SWITCHBOARD.

walls, covered by coats of cement. The floor is of Mosaic, presenting a well-finished appearance.

GENERATING PLANT.

The equipment of the generating plant comprises a 35 k.w. Edison-Hopkinson dynamo, direct coupled to a high speed Willans engine; a 35 k.w. Siemens dynamo, also driven by a Willans engine, and a 75 k.w. multipolar General Electric generator, driven by a 100 h.p. Goldie & McCulloch horizontal engine. Space is reserved in the dynamo room for doubling the present capacity of the station. Beside this, two sets of storage batteries of 55 cells each, of the Crompton-Howell type, 800 amperes-hour capacity, render useful service in lighting the buildings at night or on holidays. A 5 k.w.

are carried 6 feet below the floor level; the rock was picked out and solid concrete masonry put in place; 1½ in. bolts are sunk 3 feet deep in best cement concrete. The foundations above the engine room floor are made of enamelled bricks placed on edge, with corners of dark red marble. Those for the Willans engines and generators were simply laid on the rock, the facing above the level of the room being of light color enamelled brick, with corners of marble.

THE SWITCHBOARD.

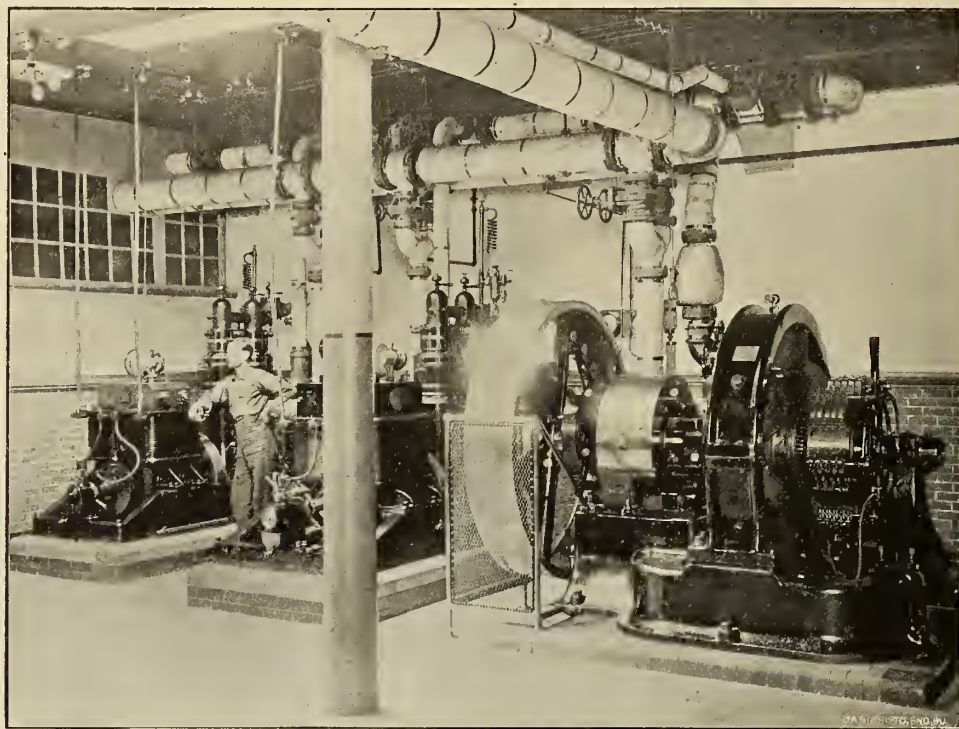
The switchboard, as shown herewith, is 16 ft. long by 8 ft. high, and supported on pedestals 18 ft. above the floor. The board is of polished black enamelled slate 2 inches thick, made up in four panels, viz.: The

lighting generators panel, the distribution panel, the power panel, and the storage battery panel. As this board will sometimes be left to the care of inexperienced people, it is so arranged that no harm can be done to the machines or apparatus by improper handling.

The lighting panels are so arranged that the buildings, containing three thousand lights, can be lighted by the two 35 k.w. dynamos in series, or, if the load is light, by one of

and Mining Building, and the Observatory. The lighting is obtained by the combination of arc and incandescent lamps. The large laboratories and testing rooms, together with the foundry and the forge, are lighted by General Electric enclosed arc lamps and long-burning lamps of different makes.

There are at present a dozen of these lamps installed. The total number of incandescent lamps is approxi-



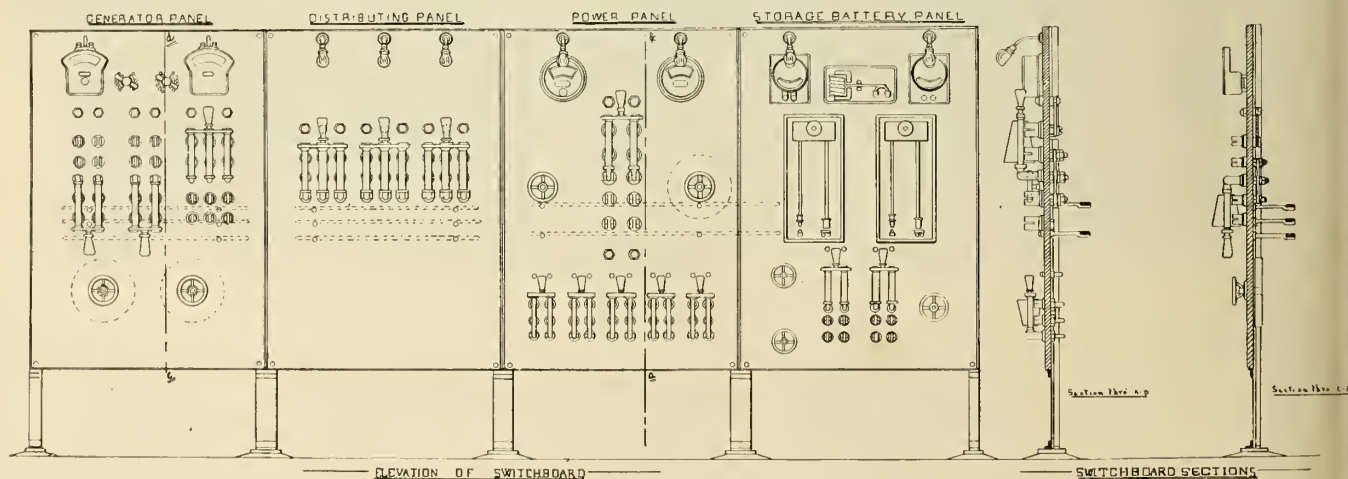
ELECTRICAL PLANT AT MCGILL UNIVERSITY.—VIEW OF GENERATING ROOM.

them running on the two-wire system, or by accumulators.

The power panel is fed from the multipolar General Electric generator, at 125 volts, there being a separate switch for each distinct power service.

The storage battery panel enables the two sets of batteries to be charged in multiple; there is an automatic circuit breaker, and Aaron watt meters to measure the charges and discharges from the batteries. Each machine possesses its amperemeter and voltmeter, and Thomson

mately 3,000. The feeders for lighting and for power are entirely separate and distinct. The motors, with the exception of fan motors, are not allowed to be placed on the lighting mains, while the general arrangement of the feeder system for light and power is such that each building has entirely separate sets of conductors from the switchboard. The going-out feeders are carried through a vertical recess, built over the switchboard, leading to the roof of the dynamo room. These,



ELECTRICAL PLANT AT MCGILL UNIVERSITY.

recording wattmeters are placed behind the board to measure the power demanded by each university building. Carpenter enamelled rheostats are used

THE LIGHTING SYSTEM.

The buildings receiving light and power from this plant are the following: The MacDonald Engineering Building, the Workman Technical Building, the MacDonald Physics Building, the MacDonald Chemistry

fourteen in number, are led to the different buildings on iron brackets and steel poles. In entering the buildings the feeders are run in iron-armoured conduit to main switches, so as to be able to cut out the buildings entirely from the mains.

THE MOTOR SYSTEM.

The motors used for driving the various classes of machinery in the different buildings vary in size from 1

to 25 h.p. In the Engineering building electric motors are made to drive pumps, crushing machines, elevators, fans and shafting of all kinds, for ordinary work and experimental purposes.

In the Mining and Chemistry building the entire equipment of machinery is driven by electric motors. In the Physics building a battery of storage cells, for experimental purposes, is charged from a motor-generator. Electric motors are also in use to run fans and machines of different kinds. The total horse power in electric motors is estimated at 135 h.p.

The Engineering building, the Workman building and Physics building are wired on the three-wire system. The Mining building is of the ordinary two-wire system. When the load is light, i.e., during the day, the multi-polar 75 k.w. is run alone to supply both light and power to the buildings. The pressure for the motors is 125 volts, but this is reduced for the lights to 105 volts through a dimmer. When the load for light exceeds 50 amperes, the lighting load is thrown on one of the Willans engines running on the two-wire, or with the two Willans running on the three wires.

The motors are all stopped at five o'clock, the multi-polar generator being then available for lighting pur-



MR. L. A. HERDT, E.E., M.A.E.

poses. If, therefore, the load has exceeded the capacity of the two Willans engines, either one of the buildings can be thrown on this new machine. The plant has now been in operation one year, and has given entire satisfaction.

The total capacity of engine is 200 h.p.; of generators, 145 k.w. The rated capacity of all motors installed is 135 h.p., and there are 3,000 incandescent lamps put up and a dozen arc lamps. During this time the load at the switchboard has been approximately 50 h.p. during day-time, increasing to a maximum of 100 h.p. from 4.30 to 6.30 p.m.; at that time the batteries are thrown in. The two batteries are placed in parallel when the demand exceeds 100 amperes. If the load is very light, one battery alone is placed in circuit, but an electromagnetic device will put in circuit the other battery if the first should show signs of being discharged or of failing to do the work. These batteries, situated in a well-ventilated room beside the dynamo room, have been in operation for the last five years, and though some difficulty was experienced with them at the start, they are now working very satisfactorily. Daily records of power produced are taken; this is recorded by wattmeters placed in circuit both on the machines and batteries. It is impossible, however, to determine the

actual consumption of the plant, for the same boilers provide steam for other purposes than that of the lighting plant. A large amount of electric power is also absorbed by experimental work done in the electrical laboratories and experimental dynamo room.

L. A. HERDT, E.E., M.A.E.

The total electrical plant was designed and all the details of the engineering drawn up by L. A. Herdt, E.E., M.A.E., Lecturer in Electrical Engineering, McGill University, and under his supervision the equipment was installed.

Mr. Herdt, a portrait of whom we present, graduated in the mechanical engineering course, with honors, in 1893. He was laboratory assistant in the Laboratoire Central d'Electricite, Paris, and then took a course in electrical engineering at the Electro-Technical Institute, Montefiore, Liege, Belgium, taking the degree of E. E. with highest honors. In September, 1894, he was appointed assistant chief electrical engineer to the Thomson-Houston International Company, and one year later accepted the position of demonstrator of electrical engineering at McGill University, with charge of the electric light plant. In the succeeding year he was appointed lecturer in electrical engineering. During the summer holidays he is engaged in consulting engineering work. The degree of Master of Engineering was conferred upon him at the last McGill University convocation.

OTTAWA ELECTRICAL ASSOCIATION.

A COUPLE of informal meetings have been held by a number of Ottawa electricians for the purpose of forming an association which will be of interest technically and socially to those engaged in electrical pursuits in and about the city of Ottawa. A committee, with Mr. B. Nolan as chairman and Mr. E. O'Reilly secretary, has been appointed to draft a constitution and by-laws and report to another general meeting, at which officers for the Ottawa Electrical Association will be elected. It is the intention of the prime movers in this matter to complete all preliminary arrangements during the coming summer and to start work in earnest early next fall. The reading of papers, lectures by prominent electricians, and discussions on current topics, intermingled with social features, comprise the proposed programme for next winter. The mutual advancement of members will not be lost sight of, and a proposition to incorporate a beneficiary clause in the constitution will be dealt with at the next meeting.

The Laurentide Pulp Company, of Grand Mere, Que., have ordered two 55 kilowatt direct connected generators from the Canadian General Electric Company.

The Brantford city council has invited tenders for lighting the city by 120 arc lights of 2,000 candle power and 80 incandescent lamps of 32 candle power, and also for furnishing a municipal plant.

The Cataract Power Company have made a proposition to the city of Hamilton to pump the water supply by electricity. The city engineer has reported against the acceptance of the offer, but the council has decided to engage an expert to report on the relative cost of steam and electric power for pumping purposes.

The Electric Reduction Co., of Buckingham, Que., have ordered from the Canadian General Electric Company a 1000 h.p. three-phase revolving field generator. This machine is of the same general type as those supplied for Lachine and West Kootenay, except that it is wound for the very low potential of 75 volts. It will be direct connected to the jack shaft, running at 165 revolutions per minute, and will be by far the largest generator now in use in Canada for electrolytic purposes.

THE COMPARATIVE ADVANTAGES OF STEAM AND WATER POWER.

BY "ECONOMY."

Now that the attention of the public is being closely directed to the possible utilization of the many valuable water powers which we have in Canada, it may be of interest and advantage to consider their value in comparison with the best known alternative method of generating energy, viz., by steam. The practical side of the question may almost be neglected, because modern science has so improved hydraulic machinery that the best classes of water wheels may be placed about on a par with steam engines as regards regularity of service and general satisfactoriness. The main interest will center in the commercial features of the comparison—and might take the form of the question, "Under what circumstances is water power a more economical prime mover than a steam engine?" which leads to the next question, "Can there be conditions which will cause steam power to be more economical than water power?" Both steam and water power, in what may be called their "raw" state, must be rendered available for use by more or less expansive processes, including in many cases the transmission of the energy from the point of production to the point of utilization; and it will be evident that there may be many conditions, physical and commercial, which may have considerable effect in modifying the value of one form of energy in comparison with the other.

Our rivers and streams are most of them short, and the country through which they run being denuded rapidly of forests. Hence they are very sensitive to the precipitation and respond very rapidly to it, being swollen shortly after rains, and carrying off large volumes of water in a short space of time. Similarly, after a period of dry weather they shrink to sometimes a very small proportion of their maximum flow. Even those streams which rise in marshy localities which absorb and retain moisture better, largely depend on the character of the fall weather. Should there be a considerable snowfall before the severe cold sets in to freeze the ground, then the stream will keep a more steady, even flow during the winter than it will if the hard frost sets in before the snow. And if the somewhat exceptional condition be met with of a dry summer, with little precipitation, followed by an early and severe frost without snow until late in the fall, then it is probable that many streams would dry up almost completely for several weeks, if not months. Water, therefore, as a source of power, can not be considered always satisfactory in point of reliability, unless some means can be taken for averaging up the flow; storing up the excess in times of flood, and letting it go in times of low water. This expedient is well recognized and frequently adopted; but the expense of the storage reservoirs is likely to be so great that only peculiar commercial conditions would justify it. The cost of development of a water power also is an item that may become very serious. It is but seldom that the favorable condition is found of plenty water and a large direct fall. As a rule the large streams, particularly in Ontario, have a somewhat slow current, and a high head could be obtained only by carrying the water in a long canal, which would cost heavily.

It is therefore evident that, taking everything into consideration, the first cost of a water power plant to render available a certain definite, continuous horse power, depends on the cost of machinery, dams, and perhaps storage reservoirs. If the power required does not exceed the minimum flow, then the reservoirs are not required; but they will be if the average flow is necessary. Hence it is quite possible that the total first cost of a water power enterprise, including the wheels, may be even largely in excess of the total first cost of a steam plant of the same horse power capacity. In fact, unless the circumstances be altogether exceptional, it is not likely that water first cost will compare at all favorably with steam first cost. After the first cost of the two systems comes in a very important consideration—purely commercial in its character. Manufacturing establishments using power require transporting facilities for their raw material, and for their finished product; and just in proportion as these are bulky or heavy, so does the cost of their transport become a more potent factor in deciding whether cheap power or low freight is of greater importance. More especially is this so in establishments that do a principally foreign trade, and hence require convenient access to a sea or lake port. It is a somewhat unfortunate circumstance, but in the nature of things, that the largest commercial and transporting centers are far from any considerable and swift streams. We all know of the observant traveller who remarked on the peculiar coincidence that there was always a navigable stream close to a large manufacturing city, and

therein lies the answer to the question why cities are not near water powers; because navigable waters are very generally of greater importance than very inexpensive power. Hence the value of a water power largely depends on its position with regard to railways, canals, or navigable streams. Here, however, comes the very important fact that we have several distinct means of transmitting power over considerable distances; so that although the best place for generating hydraulic power may be distant from the most convenient shipping point, the intervening space may be bridged. Readers of the NEWS are, of course, more especially interested in the electrical transmission of energy, so only that method will be considered.

Power laid down in form convenient for use at any particular spot costs money to develop, and more money to operate; and whether steam or water power is the better for any particular case can only be arrived at after careful estimate of their respective total costs per year. These total costs may be divided into fixed and variable expenses. Among the former are interest on money invested, maintenance and depreciation, insurance, wages, and the like; among the latter are fuel, oil, and the like. Every enterprise is expected to pay a fair rate of interest on the investment; most have some bonded indebtedness which is a first charge on income, and therefore interest on investment is a fair charge in making the comparison. No machinery, building, construction, or apparatus of any kind can be expected to last forever, so that estimating its life at whatever length may be proper in the light of experience, it is only sound business to lay by every year out of the gross income a sum equal to the yearly deterioration in value, so that at the end of the plant's useful life it may be found to have paid back the money invested in it. This yearly sum may be expressed in terms of a percentage of the total cost, the actual percentage varying with the class of construction or apparatus. A sum must always be allowed for maintenance, repairs, &c., and for insurance, and the wage account is always a very considerable proportion of the expenses of operation. All the above items can be calculated very closely, and placed at a pretty accurate yearly sum. Variable expenses can also be estimated sufficiently close for purposes of estimate. This is an expense which is saved in water power enterprises for the most part, and as fuel is generally one of the larger expenses, the great advantage of water comes in here. To compare the above item by item: Whether steam or water power be used, the interest percentage will be the same, so that the respective charges on this account depend entirely and solely on the respective costs of the two methods. If the whole hydraulic construction be more expensive than the equivalent steam plant, then the hydraulic interest charge will be greater than steam interest charge, and similarly. This requires a mere comparison of estimates of investment. In the depreciation account this equality is not preserved. The hydraulic plant will probably be far more durable than the equivalent steam plant. The dams will last all the longer as they are more solidly built, and a small sum spent yearly in inspection and repairs will cause them to last indefinitely. Besides which a "second hand" dam and water privilege is just as valuable as one brand new, if it has been properly maintained, which cannot be said for a second hand steam plant. Probably a fair depreciation on the whole dam, gates, tail race, &c., can be placed at 2%. Of the hydraulic plant, wheels, regulators, shafting, &c., a reasonable life of 25 years may be expected, with the consequent depreciation percentage of 4%; building 2%, if of solid brick or masonry construction. The insurance charge will be considerably less in a hydraulic than in a steam plant, and will be smaller as the building is less fireproof. It must also be remembered that the first cost of the hydraulic building will very probably be quite appreciably less than that of the steam building.

The same items in a steam plant may be reasonably taken at: For boilers, a life of 10 to 15 years, depreciation percentage, 10%; engines, shafting, journals, piping, 20 years, percentage 5%; insurance probably 25 cents per \$100 higher than with water. As to the wages charge, it is probable that a hydraulic plant can be operated just as efficiently as a steam plant, with fewer men, and consequently smaller wages expense. The larger the plants the better for the hydraulic, for while one man cannot properly attend to more than so many boilers and keep good steam, owing to the work increasing as the battery is large, the additional size or number of water wheels imposes no greater work on the operators. It may be fairly pointed out that there are labor-saving devices, such as automatic stokers, which increase the work efficiency of the firemen very greatly, enabling one man to keep good steam on a number of boilers, but at the same time it is wise

to remember that all such devices increase the complexity of a steam plant, raise the probability of accident, and render advisable the employment of higher class engineers at greater expense. In plants of a certain capacity it is necessary to employ both engineer and fireman, one man not being sufficient. In a water power one man would be quite capable of looking after the entire plant, hence the other man's wages are saved; and one superior mechanic can do the work of two and save considerable. The great importance of this item will be evident when it is considered that the saving of \$1 per day or \$300 per year (about the usual wages of a fireman) will pay the interest at 5% on \$6,000. This means that a water power plant may cost \$6,000 more than a steam plant of equal size, and be an equally good investment, if thereby one fireman's wages can be saved.

The most important item among the variable expenses is undoubtedly the fuel, which will vary very greatly according to locality, kind of business, state of markets, etc. In coal mining localities refuse can be obtained for almost nothing—for the expense perhaps of carting it from the pile; in others good steam coal costs as high as \$6, \$7 or \$8 per ton. Wood varies according to locality from 75 cents to \$2.50 a cord. Oil or gas fuel can be obtained in certain favored localities. It is of course obvious that as fuel—whether coal, wood, oil or gas—is less expensive, so does the value of a water power become less in comparison with that of steam. Another very important commercial consideration—coal fields are always well supplied with railroad facilities, sometimes even with canals—so that the two most important manufacturing advantages are found together: easy transport and cheap power. Nature herself seems to place obstacles in the way of hydraulic power, for just as a large stream has a greater fall along its course, so does it become more difficult for railways to follow it, owing to the grades. Hence it is generally necessary to transmit hydraulic power for some considerable distance to a convenient shipping point, and this means larger fixed charges to offset the entire elimination of the fuel charge. It is obvious that assuming a sufficiently low cost of fuel at the shipping point, and an expensive water power and transmission plant, there may easily be conditions which will make a water power of no value whatever in comparison with steam. For instance, in a recent case, to develop and render available a certain water power for use 12 hours a day for 365 days a year, required the damming of some storage lakes, and the transmission electrically of about 150 h. p., in all about \$20,000. The expenses in connection with this enterprise, for interest, depreciation, wages, etc., were estimated at \$2,700 per year. The cost of a steam plant to do the same service was estimated at \$8,000. Now, taking the above percentages and allowing two men for the steam at \$800 wages, the same expenses without fuel would come to about \$1,500. Thus \$1,200 are allowable for fuel in order that steam and water (electrically transmitted) may be equally good investments. This allows \$8 per horse power year for fuel. Or allowing 4 lbs. of coal per h. p. h. (condensing) comes to the equivalent of 1080 tons of coal per year. Coal, or equivalent, at \$1.11 per ton would make either plant an equally good investment; at \$1.12 would be more expensive than water power; at \$1.10 would be more economical than water.

Now, if this water power had been situated about 100 miles from where it was, and placed as near a Nova Scotian coal mine as it was to its distributing point, then culm could have been obtained at 25 cents per ton, and allowing even 4 tons of culm to give as good effects as one ton of good steam coal, even then the steam plant would have been the better investment. At the distance of 32 miles from the above coal mine, culm cost \$1 laid down, so that the fuel for the above plant would have greatly exceeded the \$1,200 allowed. Here we have a very clear illustration of the way in which the comparative values of steam and water power vary. At one end of a 32 mile line the water power was worth nothing at all; at the other end it would have been a good investment for \$25,000.

The kind of business to be done will also largely affect the comparison. There are many products that require heat in the various processes, for bleaching, cleaning, bending, drying, and what not. In the present state of our knowledge of electrical matters, it is not wise to predict what may or may not be done in the next few years in the way of electrical heating, but we do know that water power will not develop heat without its transformation into electrical energy; so that unless this transformation is made, a water power plant will have to be supplemented by a steam heating plant in all cases where heat is required. If not a steam heating, then hot air, stoves, &c., which all mean fuel.

Now, if steam is to be used at all, it might just as well be used as economically as possible, and to raise steam to a high pressure costs less proportionally than it does to generate a low pressure. If, therefore, high pressure steam be used in steam engines, and their exhaust be availed of for drying or heating purposes, it might very well be that the expense incurred would compare very favorably with the total interest and other expenses of a combined water power and steam heating plant. And the comparison would be all the more favorable to steam as steam became necessary in larger quantities for drying and less comparatively for power. There are other industries again which necessarily produce combustible refuse, which they must consume in some way, such as tanneries, planing and saw mills, and other wood working industries. Unless they have some local demand for such refuse it becomes very necessary to burn it up to get it out of the way. In all such cases it is questionable whether water power would have any value at all.

In appraising the comparative values, therefore, of a water privilege in relation to steam working, it becomes necessary to regard the whole question from a strictly commercial standpoint. The total first cost by the two methods must be reliably estimated, with their probable maintenance and operating costs. Due consideration must be given to the cost of extra haulage and handling, where the water power is not on the transport line, and be debited against it. The heating problem is a factor, and the cost of fuel, and if the careful discussion of the matter leads to the result that steam is the more economical, then no arguments based on the "sin of wasting power at our doors" should be allowed to influence it. It is obvious that no particular rules can be laid down by the application of which the value of water power can be determined from tables like a logarithm. Every case must be determined on its merits, and the above illustration showing how the merits may vary widely in 32 miles, serves to emphasize the importance of careful investigation and logical calculation.

MOONLIGHT SCHEDULE FOR JUNE.

Day of Month.	Light.	Extinguish.	No. of Hours.
	H.M.	H.M.	H.M.
1....	A.M. 12.40	A.M. 3.40	3.00
2....	No Light.	No Light.	.....
3....	No Light.	No Light.	.....
4....	No Light.	No Light.	.....
5....	No Light.	No Light.	.....
6....	P.M. 7.50	P.M. 10.50	3.00
7....	" 7.50	" 11.30	3.40
8....	" 7.50	A.M. 12.30	4.40
9....	" 7.50	" 12.50	5.00
10....	" 7.50	" 1.00	5.10
11....	" 7.50	" 1.20	5.30
12....	" 7.50	" 1.50	6.00
13....	" 8.00	" 2.20	6.20
14....	" 8.00	" 2.50	6.50
15....	" 8.00	" 3.20	7.20
16....	" 8.00	" 3.30	7.30
17....	" 8.00	" 3.30	7.30
18....	" 8.00	" 3.30	7.30
19....	" 8.00	" 3.30	7.30
20....	" 8.00	" 3.30	7.30
21....	" 8.20	" 3.30	7.10
22....	" 8.40	" 3.30	6.50
23....	" 9.10	" 3.30	6.20
24....	" 9.40	" 3.30	5.50
25....	" 10.00	" 3.30	5.30
26....	" 10.30	" 3.30	5.00
27....	" 10.50	" 3.30	4.40
28....	" 11.00	" 3.30	4.30
29....	" 11.30	" 3.40	4.10
30....	" 11.50	" 3.40	3.50
.....			

Total..... 147.50

Some of the ratepayers of Springhill, N. S., favor the purchase by the town of the electric light plant. The price now paid is \$20 per light for 28 lights for a part night service.

The Canadian Motor Syndicate is looking for a site for a factory, the purpose being to manufacture motor vehicles. This is the company in which Mr. A. H. St. Germain is interested.

The Coaticook, Que., Electric Light Company has elected the following directors: President and treasurer, H. Lovell; secretary, W. L. Shurtleff; managing director, F. E. Lovell; P. T. Baldwin, J. H. Morgan and W. L. Shurtleff. A semi-annual dividend of 3 per cent. was declared.

TORONTO TECHNICAL SCHOOL EXAMINATIONS.

THE Toronto Technical School has just closed a very successful term, the classes being largely attended. In the "Electricity" and "Steam" courses (Mr. Harris P. Elliott, B. A. Sc., Lecturer) the following students successfully passed their examination:

Junior Electricity—Class I.—M. Watts and I. F. Jackson (equal); A. J. Watkins and W. A. Ratcliffe (equal); D. T. Brown, H. Hargreave; R. Yeomans and H. J. Lillie (equal); G. H. Pargeter and W. K. Greenwood (equal). Class II.—A. H. McBride, H. B. Jewett, A. A. Strathdee; C. W. Moir and T. C. McAree (equal); H. Buck and T. S. Buck (equal). Class III.—R. G. Archer, J. Stevenson.

Senior Electricity—Class I.—Alex. Gerry, T. Brown; John A. Whyte and J. E. B. Hancock (equal). Class II.—G. H. Robinson. Class III.—W. K. Greenwood, S. J. Evason, K. A. McKae.

Steam and Steam Engine (junior).—Class I.—Alex. Gerry and J. B. Hancock (equal). Class II.—D. T. Brown, John A. Whyte. Class III.—T. Steels, R. Quinn, T. C. McAree, G. D. Bly.

Steam and Steam Engine (senior).—Alex. Gerry, T. C. McAree.

Below will be found a copy of the examination papers in the above subjects:

ELECTRICITY AND MAGNETISM.

1. Define: Magnet, Consequent Poles, Magnetic Induction, and give the Laws of Magnetism.
2. What is the nature of the so-called lines of force? What do they represent? How would you determine their presence and direction?
3. Two bar magnets are placed on a table with their north poles pointing towards each other and about $1\frac{1}{2}$ " apart. A sheet of glass is placed over these and iron filings are sprinkled upon it. Show how these arrange themselves, and explain clearly why they do so.
4. What are the essential parts of a voltaic cell? What is polarization? Describe any single fluid and any double fluid cells which do not polarize.
5. Give several methods of showing the presence of a current in a wire. How could you determine its direction?
6. Two copper plates of equal weights are placed in a solution of copper sulphate and a current of 5 amperes is passed through from one end to the other for 10 hours. What is then the difference in weight? Electro chemical equivalent of copper 0.0003261.
7. If the plates in the previous question were of platinum, describe exactly what would take place if the current were passed through as long as possible. What would stop it?
8. Describe any form of galvanometer. What points in its construction make it sensitive?
9. What is meant by self-induction? Show how it affects the action of the induction coil and how this effect is partly got rid of by the use of a condenser.
10. State Ohm's law. Explain it fully.
11. Twelve incandescent lamps, each having a resistance of 200 ohms, are put in series across the terminals of a 500 volt circuit. What current passes?
12. What is the best method of grouping 12 cells, each having a resistance of 3 ohms and an E.M.F. of 2 volts, in order to get the greatest possible current through a lamp whose resistance is 4 ohms. What is the current?
13. Twenty pounds of copper is made into a wire 1,000 feet long, having a resistance of 1.5 ohms. If it had been made into a wire 2,000 feet long, what would have been its resistance?
14. Three wires have resistances of 5, 10 and 15 ohms, what is the combined resistance in series and in parallel?
15. Describe any method of measuring resistance.
16. Describe a simple telegraphic circuit, showing the instruments and how connected.
17. Give a diagram showing the connections on an induction coil.
18. Describe any form of telephone transmitter and receiver.

SENIOR ELECTRICITY.

1. Name various methods of producing Electricity. Why is the method of induction so important?
2. Describe briefly how to demonstrate the laws of induced currents by means of the following apparatus: A galvanometer, two coils of wire, a battery, a bar magnet and a bar of soft iron.
3. In all cases of electro-magnetic induction the induced currents have such a direction that their reaction tends to stop the motion which produces them. A current flowing contra clockwise produces a north pole, and the lines of force are considered

to be proceeding from a north pole. From the above facts deduce a rule similar to Fleming's.

4. Upon what does the E.M.F. of a dynamo depend? Deduce the rule

$$E = \frac{N.C.n.}{10^8}$$

5. Explain the cause of sparking at the brushes of a dynamo. How does shifting the brushes prevent it? When is it impossible to prevent it by this means?

6. Why does a shunt-wound dynamo not give a constant voltage? What arrangement is used to make it do so?

7. Give a practical method of determining the number of series turns required to compound a given dynamo.

7. Obtain the formula for the efficiency of a shunt dynamo in the form

$$\text{Efficiency} = \frac{CA}{(B+C)(A+B+C)}$$

$$\frac{1}{B} = \text{Shunt resistance.}$$

$$\frac{1}{C} = \text{External resistance.}$$

$$\frac{1}{A} = \text{Armature resistance.}$$

9. Explain: Friction, Hysteresis and Eddy current losses. What point in construction reduces the latter to a minimum?

10. An iron ring has a cross-section 10 square C.M. and a diameter of 20 C.M. We wish to send around it 120,000 lines of force. How many ampere turns must be provided?

$$\frac{B}{H} = 1000$$

11. Give any method of measuring resistances.

12. Several of the wires in a lead-covered telephone cable are found to be grounded. How will you determine the position of the fault?

13. Why does weakening the field of a shunt motor cause it to run faster? How is it that a shunt motor supplied with current at a nearly constant voltage can be made to run at a nearly constant speed?

14. Describe any form of electric meter, mentioning its good points and also its defects.

15. What is the external characteristic of a shunt-wound dynamo? Make a diagram showing how apparatus could be arranged to get the characteristic of a small Edison machine wound for 110 volts.

STEAM AND STEAM ENGINE (SENIOR.)

1. Define: Super saturated, saturated, and super heated steam, total heat, heat of the liquid and heat of vaporization.
2. A boiler was found to evaporate 15,000 pounds in a 10 hours' run. The feed water was raised to a temperature of 200° F. by means of the exhaust. The average gauge pressure was 85 pounds. Find the equivalent evaporation from and at 212°.
3. What is meant by a standard boiler horse power? In the previous question what standard B.H.P. was developed?
4. How does the production of wet steam affect the efficiency of a boiler?
5. Describe any modern type of water tube boiler, and name some of the advantages claimed for it.
6. Give rough sketches of various water tube boilers to show the arrangement of the parts; indicate by arrows the direction of the water circulation and of the hot gases. Show the position of the feed water pipe.
7. A marine boiler is to be 20' in diameter, and to withstand an internal pressure of 125 pounds per square inch, allowing a factor of safety of 4 and a tensile strength of 60,000. What material would you use and what thickness, assuming that the ends are stayed and made as strong as the shell?
8. An engine is to cut off at $\frac{3}{4}$ stroke, to have a maximum port opening of $\frac{5}{8}$ " and lead of $\frac{1}{8}$ ". The exhaust is to open at 90% of the stroke. Show how to find the inside and outside lap of the slide valve, the throw and the advance angle of the eccentric.
9. How would you set the slide valve in the above engine to give it an equal lead at both ends? How would you set it to get twice the lead at the head end as at the other?
10. Draw a card such as might be taken from a Corliss engine, and explain how to determine from it the steam used per I.H.P. per hour.
11. Explain fully the effect of condensation by the cylinder walls on the efficiency of an engine. What methods are used to reduce this effect?
12. Define Work, Power, Horse Power. A hoist is to elevate one ton (2,000 lbs.) of coal 50 feet high in 3 minutes. What horse power is required?
13. If you know the dimensions, speed, valve motion and working steam pressure of a given engine, how will you compute its probable I.H.P.?
14. Two exactly similar locomotives are put on a level track and made to pull against each other. They stand still with their wheels revolving at the rate of 300 R.P.M. The drivers are 6' in diameter and a spring which is used to couple the engines shows that they pull against each other with a force of 1,500 pounds. Find what horse power is being developed by each.

John A. Coryell, C.E., Midway, B. C., has been making surveys for the proposed utilization of the water power of the Kettle river at Cascade Falls. Quite lately the Cascade Development Company disposed of their rights in the water power to an English syndicate, which is represented by C. K. Milbourne, Nelson, B.C., and for them the work has been done. A large power plant is projected.

THE MARITIME ELECTRICAL ASSOCIATION.

A MARITIME Electrical Association was duly organized at a meeting held at the Halifax Hotel, Halifax, N. S., on the 12th of April. There was a good attendance and all seemed to realize the need of such an association and were unanimous in their support of what had been done. A constitution was adopted, and the following officers were elected :

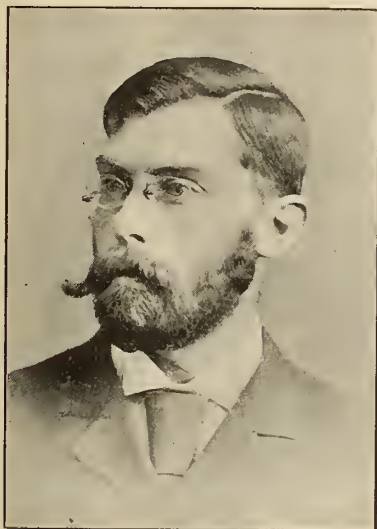
President, F. A. Bowman, New Glasgow, N. S.; Vice-President, H. Colpitt, city electrician, Halifax, N. S.; Secretary-Treasurer, J. H. Winfield, local manager Nova Scotia Telephone Co., Ltd., New Glasgow, N.S., also a representative executive committee from the three provinces.

It was decided to hold the first regular convention in Halifax some time in September.

We have the privilege to present to readers of the ELECTRICAL NEWS brief personal sketches and portraits of the executive officers, under whose experienced guidance the new organization may be expected to prosper, and prove of much advantage in advancing the welfare of the electrical industry in the provinces by the sea.

MR. FRED. A. BOWMAN, M.A., B.E.,

President of the new association, is a native of Nova Scotia, having been born at Windsor, and has had a



MR. FRED. A. BOWMAN, M.A., B.E.,
President Maritime Electrical Association.

varied and valuable experience in engineering and electrical work. He is a graduate in arts and mining engineering at King's College, in his native town, and worked a couple of years at mining and kindred work. He was afterwards employed in the locomotive shops of the I. C. R. and in the office of E. Vassnack, M. E., Halifax. He subsequently took the expert course at the Thomson-Houston Works at Lynn, Mass., and also held a position with the New York office of the same company. Mr. Bowman spent a year in the employ of the Royal Electric Company of Montreal. Since 1892 he has occupied the position of superintendent of the New Glasgow Electric Light Co., Limited, of New Glasgow, N. S. Mr. Bowman is an associate member of the Canadian Society of Civil Engineers, and a member of the American Institute of Electrical Engineers.

MR. H. COLPITT,

Vice-President, was born at Forest Glen, New Brunswick, in 1861. Immediately after leaving school a few years were spent on the road as a commercial traveller. He entered the employ of the Halifax Electric Light

Company shortly after the inception of electric lighting in the maritime provinces. When the company was sold out to the gas company Mr. Colpitt's services were retained, and after two years he was appointed superintendent of the electric lighting plant. This position he held until 1897, when he received the appointment of city electrician for Halifax. Mr. Colpitt, although quite



MR. H. COLPITT,
Vice-President Maritime Electrical Association.

a young man, is entitled to be regarded as one of the veterans of the electric light business, having had an experience therein extending over thirteen years.

MR. J. H. WINFIELD,

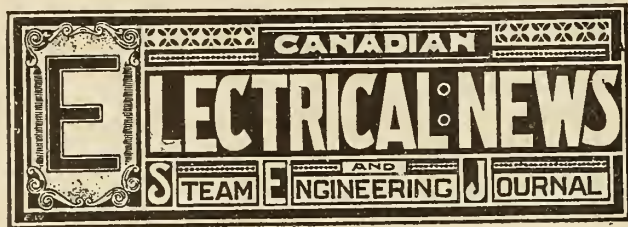
Secretary-Treasurer, is a native of Derby, England, and was educated in London. He took the electrical engineering course at Peoples' Palace, and received a good mechanical training in the shops of Hammersley Bros., scientific instrument makers, Barnsbury, London. In the fall of 1891 he came to Nova Scotia and accepted a position in the Halifax office of the Nova Scotia Telephone Co., Ltd. In March, 1893, he was transferred to New Glasgow, to take charge of the company's exchange there. In October he was made superintendent



MR. J. H. WINFIELD,
Secretary-Treasurer Maritime Electrical Association.

of their eastern division, with headquarters at New Glasgow, which position he still retains.

Sixteen thousand dollars is said to be the record price paid for a cablegram, that price having been paid for a message sent by Heniker Heaton to Australia in behalf of the British Parliament.



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The ELECTRICAL NEWS will be mailed to subscribers in the Dominion, or the United States, post free, for \$1.00 per annum, 50 cents for six months. The price of subscription should be remitted by currency, registered letter, or postal order payable to C. H. Mortimer. Please do not send cheques on local banks unless 25 cents is added for cost of discount. Money sent in unregistered letters will be at senders' risk. Subscriptions from foreign countries embraced in the General Postal Union \$1.50 per annum. Subscriptions are payable in advance. The paper will be discontinued at expiration of term paid for if so stipulated by the subscriber, but where no such understanding exists, will be continued until instructions to discontinue are received and all arrearages paid.

Subscribers may have the mailing address changed as often as desired. When ordering change, always give the old as well as the new address.

The Publisher should be notified of the failure of subscribers to receive their paper promptly and regularly.

EDITOR'S ANNOUNCEMENTS.

Correspondence is invited upon all topics legitimately coming within the scope of this journal.

The "Canadian Electrical News" has been appointed the official paper of the Canadian Electrical Association.

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KINCARDINE BRANCH NO. 12.—Meets every Tuesday at 8 o'clock, in McKibbin's block. President, Daniel Bennett; Vice-President, Joseph Lighthall; Secretary, Percy C. Walker, Waterworks.

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Information regarding examinations will be furnished on application to any member of the Board.

It occasionally happens that a slight defect in some part of an electrical plant, which could probably be remedied in the simplest possible manner, results in the condemnation of the entire machinery, owing to lack of knowledge on the part of the person in charge of the plant. It is not unusual to hear of the manufacturers being called in to adjust some difficulty, only to find that the trouble was of the most trifling nature, and such as should have been readily ascertained and put right by the electrician. The cause of such a condition of affairs is frequently to be found in the low salaries paid to superintendents and operatives. These salaries offer no inducement to competent men, possessing the knowledge requisite for the efficient operation of an electric light plant, and hence the engineer with a smattering of electrical education is employed to do the work. It is not to be wondered at that so many so-called breakdowns occur. It is false economy to buy an up-to-date plant and place an inexperienced person in charge. This fact is rapidly becoming recognized, and the result will be a greater demand for properly qualified electricians.

Canadian Electrical Association.

As the date for the annual convention of the above Association at Montreal draws near, interest in the event is deepening. At the last meeting of the Executive a considerable number of new members were elected. Other applications are constantly coming in to the secretary. Each individual member of the Association should endeavor to add new members to the roll and assist in swelling the attendance, so that the coming convention shall be an unqualified success. Montreal, aside from its many other attractions as the chief city of Canada, is the point of greatest interest to persons connected with the electrical industries. The headquarters of the Bell Telephone Company's extensive system, the large manufactory and up-to-date lighting stations of the

Royal Electric Co., the electric transmission plants at Chambly and Lachine, McGill University, with its elaborate electrical and engineering departments, will all be thrown open to the inspection of the members of the Association who may attend this convention, and will in themselves be found well worth the time and expense incidental to the visit. All the arrangements for the meeting are making satisfactory progress. The Executive will meet towards the close of the present month to receive the reports of the various committees, complete all arrangements, and arrange for the immediate publication of the programme.

Cable vs. Electric Tramways.

IN the Dominion of Canada cable tramways are practically unknown, but in Great Britain this method of propulsion has been adopted by some of the largest cities. The Edinburgh cable tramways were supposed to have been eminently successful, and are frequently referred to as a model system. It would seem, however, that they have not been the success which is generally supposed, as when the question of an extension was under consideration recently, several members of the city council advocated the adoption of electric traction, and the question was referred to Professor Kennedy, F.R.S., for a report. With the improvements being made in electrical apparatus, and its greater application for special purposes, electric traction promises soon to supersede all other systems.

Dangers of Acetylene.

A WOODSTOCK, Ont., paper reports the blowing to pieces of an acetylene gas generator in that city recently. The generator had been on exhibition in the rear of a cigar store. Owing to the fact that there was very little gas in the machine at the time of the accident, no serious damage was done except to the generator itself, but the tenants of the adjoining buildings got a bad scare. Over the back door of the room in which the generator was placed an overflow pipe extended out from the building. A young man who was standing in the doorway, in raising his hand to throw down a match, ignited the overflow gas. The flame travelled quickly along the gas pipe and entered the generator, causing the explosion. But for the fact that the machine was being prepared for removal and contained little gas, the consequences might have been serious.

It is supposed that incandescent lamps, when old, take more power than when new. A lamp when new may give one-third candle per watt, and after this same lamp has been burning for about 400 hours it may give one-sixth candle per watt. Lamps, as a rule, will take less energy after burning awhile than when new, but owing to the fact that the candle decreases with the life, the power per candle is greatly increased. Therefore it is more correct to say that more power is required for a given quantity of light, and as it is light that is sold, not power, it stands to reason that when maximum candle power for minimum expenditure of power is required that lamps must be renewed about once every 350 hours. In a test recently made with several makes of lamps, where each of the various lamps started with an illuminating power of about one-third candle per watt, at the end of 300 hours some of them were only giving one-ninth candle for the same expenditure of power. Truly,

there is room for improvement still in the incandescent lamp.

Car Lighting.

THE lighting of railway cars is a subject which has received much attention of late from both railway companies and manufacturers of electrical machinery. Many systems have been devised, but so far none have given entire satisfaction. The equipment which has recently been placed on the sleeping car Winchester by the Canadian Pacific Railway Company probably comes nearer a solution of the problem than any other, the results produced giving promise of ultimate success. The current is generated from the axle by the motion of the train, and the surplus current is stored in a battery, which maintains regular current and provides also for stoppages. It is said that there is little flickering or irregularity in the light, although in some respects the system is not all that could be desired. That electricity will furnish the future light for railway cars is now almost certain.

As regards the advantages derived from municipal ownership and operation of public services, the New York Post,

one of the ablest public journals of the United States, says: "Municipal ownership is one of those phrases which, in a certain order of mind, take the place of reasoning, investigation, common sense. It is invested with a magic, a miracle-working, power which makes anything claimed for it credible. The city gas works in Philadelphia were long the substitute for argument in the mouths of advocates of municipal ownership. But their recent abandonment, after confessed losses and scandals, has led the champions of municipal operation of the public lighting and transit services to look more and more abroad for comfort, and Glasgow is the city whence they have derived most of it. So wild have been the romances set afloat about the immense profits derived by Glasgow from its control of public franchises that the Lord Provost has been compelled to issue the following circular letter:

"The Lord Provost of Glasgow has received communications from all parts of America desiring confirmation of a statement to the effect that the citizens of Glasgow would be free from all taxes or rates in consequence of the profits derivable from their gas, water, electric lighting, and other undertakings of the government. I have accordingly been requested by the Lord Provost to inform you that this statement has no foundation in fact. There is no probability of this city being exempt from taxation.

"JOHN S. SAMUEL, City Chambers."

Thus is the socialistic millennium adjourned again. Taxes are not yet abolished, even by municipal ownership. Yet there is little doubt that if municipal ownership were given free course, it would ultimately make an end of taxes, for it would make an end of property to be taxed."

Electricity in Mexico.

IT is reported that the valuable water powers which abound throughout Mexico are rapidly being taken possession of with a view to their profitable utilization. The cataract at Juanacattan is said to be second on this continent to that of Niagara. There has recently been installed an extensive plant costing \$700,000 to convey electricity for power purposes from the Cascade of Regea to several mines and factories fifteen miles distant. The hydraulic force is utilized by means of Pelton water-wheels, driving five tri-phase dynamos, each of 400 h.p., one of which is kept as a reserve, and two excitors. The tension of the current, as received from the dynamo, is 700 volts, which by means of step-up transformers is

increased to 10,000 volts for transmission. Three bare conducting copper wires about one-third of an inch in diameter, carry the current. The loss in transmission is stated to be only ten per cent. In view of the activity in engineering work of this character, Canadian manufacturers of electrical apparatus might profitably enquire into the possibilities of the Mexican market.

Coal Consumption. In a test made in a large institution recently, it was shown conclusively that it took $12\frac{1}{2}$ lbs. coal per indicator horse power per hour. This engine was used for driving dynamos for lighting the institution. The method of driving was from engine to jack shaft and then from jack shaft to dynamos. Taking the readings with reliable volt and ampere meters, there was a loss of 40 lbs. between the engine and switchboard, showing that there was a coal consumption of 20 lbs. coal per E.H.P. at the bus. The question now arises how many more plants are there in the country taking the same coal consumption. One thing certain, this is not the only one. A plant of this kind is dear at any price, in fact it would not pay one to accept it for nothing. Let buyers of certain electric plants have certain guarantees as to the efficiency of same, and let them engage good reliable engineers to make the test to see if they have fulfilled the guarantees, and when we come to this method of doing business better results will be obtained all around.

Electrical Apparatus for Mining. RELIABLE reports from British Columbia state that the development of the gold mines in that province is being steadily proceeded with, and that there is more machinery being purchased than ever before. There is being employed a large quantity of electrical apparatus for the operation of hoists, drills, etc., and light and power companies now installing plants report the outlook for business as very promising, one favorable feature being that the demand is chiefly for large units, usually above fifty horse power. One of the largest contracts has just been closed with the proprietors of the War Eagle mine. An air compressor with a capacity of forty drills will be driven by a 300 kilowatt motor and an electric hoist by a 300 h. p. induction motor, the average working load of the hoist being eight tons. This plant is said to be the first of its kind to be used in Canada, but it will undoubtedly prove to be only the forerunner of many others, as mining development in British Columbia now seems to have reached a solid basis. There exists, we believe, the misapprehension that machinery of American manufacture is largely used in mining work. Instead of this being the case, we are informed that Canadian machinery is almost exclusively employed, and this notwithstanding that many of the mines are owned and being developed by Americans.

The work of constructing the C.P.R. telegraph line between Montreal and Vancouver was commenced on April 14th last.

The British Columbia Bullion Extracting Company, of Rossland, B. C., have ordered from the Canadian General Electric Company a 100 h.p. three phase synchronous motor and a 50 h.p. three phase induction motor to operate their works.

The Bell Telephone Company have commenced work on their new exchange in Quebec. The structure will be 30 x 88 feet, and will be built of granite, surmounted by a cornice of red copper, and will cost over \$17,000. The switchboard, which is now being made in Montreal, will accommodate 3,000 subscribers. It is expected that the new building will be ready for occupation by the month of July.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

NOTE.—Secretaries of Associations are requested to forward matter for publication in this Department not later than the 28th of each month.

ANNUAL DINNER OF HAMILTON NO. 2.

The eleventh annual dinner of Hamilton No. 2 was held in the Commercial Hotel on Thursday, April 7th. The attendance was as large as usual, and included Messrs. Wickens, Mooring, Moseley, Fox, Eversfield, Blackgrove and Bain from Toronto No. 1, and Messrs. Dixon, Richardson, Graham and Hughes from Toronto No. 2. R. Mackie presided. The menu was excellent and received due attention, after which came the following toast list: "The Queen," responded to by the company; "Canada, Our Home," by A. Hartwell; "Mayor and Corporation," by Ald. Fernside and Pettigrew; "Manufacturers," by J. McLaughlin, Toronto; "Educational Interests," by J. S. Williams; "Executive Head," by E. J. Philip and A. M. Wickens; "Sister Associations," by G. C. Mooring and J. Dixon; "Hamilton No. 2," by R. Mackie; "The Ladies," by O. P. St. John; "Host and Hostess," by Mr. Maxey.

During the evening music was rendered by the Eolean Club, and Messrs. Dixon, Stanley, Hastings, Childs, Blackgrove, Mitchell and Maranett, Mr. J. Bain acting as accompanist. A pleasant feature of the evening was several selections on the gramophone, operated by Mr. Morrice. The banqueting committee consisted of R. Mackie, chairman; J. Ironside, secretary; P. Stott, W. K. Cornish, W. Stevens, R. C. Pettigrew and R. E. Chillman.

LONDON NO. 5.

A member of the Forest City Association, referring to the competition inaugurated by Mr. G. B. Risler, a past president, writes as follows: "Mr. D. G. Campbell, Pottersburg, president of London branch, has received the first prize of \$8, and Duncan McKinley the second prize of \$5. Both men are active members of the association, and their efforts are to be commended. They have not been awarded cash prizes, but the amounts are placed to their credit with the International Correspondence School of Scranton, and is to be taken out in tuition. The question papers have had the desired effect—the competitors were compelled to make themselves acquainted with arithmetic, and to reason and study—and they frankly admit that it was hard work; but on the other hand they claim it was beneficial to them, and the prizes were received with the greatest of pleasure. The examining board consisted of Messrs. Risler, Bright, Goldart and McLean. Mr. Norris, president of Hamilton branch, is now with London No. 5, having accepted a position as engineer with the London Street Railway Company, of which Mr. Potter is chief engineer and superintendent. Mr. Norris has already made himself esteemed by the members, having given some good lectures on steam engines, boilers and electricity. He received a letter of regret from Hamilton branch, at the same time congratulating him on his success. London No. 5 is doing well, reorganized Nov. 19th, 1896, with 6 members, and now we are 27 members strong. Our meetings are held on the first and third Saturday of each month, at 7.30 p.m., in Sherwood Hall."

The Philadelphia Electrical Exposition Company propose holding an electrical exhibition in Philadelphia, commencing June 6, 1898, and continuing for one month. It is expected that a number of the exhibitors at the New York exhibition will remove their goods to this exhibition.

FENELON FALLS ELECTRIC TRANSMISSION SCHEME.

A COMPANY is in process of formation for the development of the energy of Fenelon Falls, Ont., and the transmission to Lindsay of all the power that can be used in that town. The Fenelon river connects Cameron lake and Sturgeon lake, and gives a head of 24 feet at the Fenelon village, with sufficient water to render available well over 2,000 horse power in the driest season of the year. The distance to Lindsay is nearly 16 miles, and the promoters claim that nearly 1,000 h. p. can be counted on there—not taking into account any new enterprises that may be attracted by the cheaper power. The representatives of the company are reported to have acquired the entire control of the water power from the Smith Estate, and from Messrs. Macdougall & Brandon (who operate the Fenelon electric light plant), and have also made some important contracts in Lindsay for the supply of power, including the contract for the street lighting. It is also contemplated to energetically push the lighting business in Lindsay. The complete plans have not yet been formulated, but reports say that all machinery and apparatus will be of the highest class, and some interesting engineering features will be intro-



VIEW OF FENELON FALLS.

duced. The engineering is in the hands of Mr. George White-Fraser, of Toronto, and the secretary pro tem is Mr. J. Alex. Culverwell.

ELECTRICAL APPARATUS FOR THE WAR EAGLE MINE.

THE War Eagle Mining and Development Company, of Rossland, B. C., have closed a contract for electrical machinery to operate the new plant which they are installing at their mine. The plant in question will consist of a 40 drill Ingersoll-Sergeant air compressor and a double drum mining hoist, both to be supplied by the James Cooper Mfg. Co., of Montreal. The shaft will be double compartment, and the hoist will have a capacity sufficient to handle two loaded skips, to be raised from a depth of ultimately 2,700 feet, at the rate of 1,000 feet per minute; this will be the severest duty so far undertaken by any electrical mining hoist in the world.

The electrical machinery is to be supplied entirely by the Canadian General Electric Co. The compressor motor will consist of a 300 kilowatt three phase synchronous motor, operating at 200 revolutions per minute, and operating the compressor fly wheel directly by a rope drive without intermediate shafting.

The hoist will be operated by a 300 h. p. induction motor, capable of operating up to 600 h. p., operating in synchronism at 300 revolutions per minute, and

handled by a regulator similar in style to the street railway controller. By use of a large external resistance any desired variation in speed may be obtained up to synchronism. The operation of an alternating hoisting motor of this capacity is a very nice engineering problem.

Power to operate this machinery will be obtained from the three phase circuit of the West Kootenay Power Company. In connection with the latter, it may be mentioned that the two large 1,000 h. p. revolving field generators supplied by the Canadian General Electric Company are now in position. The line, with step-up and step-down transformers, is completed, and the plant is expected to commence operation within the next two or three weeks.

CORROSIVE AND SCALE-FORMING AGENTS IN BOILER FEED WATERS.

By WM. THOMPSON.

[ARTICLE 5].

HAVING determined the nature of impurities contained in the feed water, it next becomes an important consideration as to what will be the nature of scale formed when impurities are precipitated, or what effect the water will have on boiler parts provided no scale-forming material is present.

It is quite obvious that a water containing such impurities as those in sample No. 1 described in last month's issue cannot form scale except at very high degrees of concentration, or when water within the boiler has become completely saturated; then, of course, crystallization will begin, but crystals will again dissolve when unsaturated molecules of water are brought into contact with the crystals. This form of scale will never be met with except in cases of extreme ignorance or carelessness, and need not be discussed at any length. As will be observed, however, the whole of the impurities in this water are non-volatile in the presence of heat at temperatures met with in ordinary boiler practice, and consequently as water evaporates into steam impurities are left behind, and a gradual increase in density takes place. The impurities, being soluble in water, remain in solution, and water in boiler becomes more and more saturated. Impurities being alkaline in reaction, a very high degree of alkalinity is in course of time reached. While the alkalis do not, as a rule, attack iron very readily, they attack brass alloys vigorously, reducing the metallic elements and causing a great deal of trouble, and in many cases serious damage has resulted.

Another very important reaction that sets in in waters of this kind is the formation of magnesium chloride, as mentioned in earlier articles, and as a consequence, free hydrochloric acid is liberated, which, being very corrosive even when diluted, no part of the system from boiler to exhaust on engine is quite free from danger of corrosion from this source.

The conditions under which a boiler feed water is to be used plays a very important part in the treatment required and the effect a water will have on the boiler parts. For instance, where good water is scarce, or in plants where economy has been carefully studied, it has become a common practice to use surface condensers, draining condensed water to a hot well and returning therefrom to boiler, using over and over again. In thoroughly equipped plants loss by evaporation is very small and quantity of fresh water used small, consequently the water may be returned to boilers many times daily. Waters that are low in dissolved solids in the first instance deposit very little scale-forming material. Condensed water from hot well being practically a distillate from original water, contains no scale-forming agents, and is, in the absence of oil, practically pure. This may, at first glance, be considered a very happy condition of things; unfortunately, practice has shown it to be in many cases the reverse. Instead of scale forming, the boiler parts are very often found to have suffered from pitting and corrosion. Explanation of this condition appears difficult, and corrosion of boilers has often been charged to presence of organic acids, when, as a matter of fact, the purity of the water itself may be said to be responsible. When water is sent to hot well it is brought into contact with atmospheric air, and, being pure, readily absorbs or takes into solution some of

the gaseous elements contained therein. Reference to my first article on this subject will readily explain the cause of pitting or corrosion due to the presence of free oxygen in the water.

We have already seen that the most troublesome scale-forming impurities held in chemical solution are the salts of lime and magnesia as usually met with in feed waters.

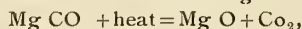
As conditions of use vary, so will nature of scale formed vary. Particularly is this the case with scale formed from the salts of magnesia. These salts in many cases are peculiarly unstable, and this fact is not sufficiently taken into account either by chemists or engineers. The carbonates of lime are, except in very exceptional cases, always accompanied by a certain proportion of the carbonates of magnesia. Personally, in my experience I have never found carbonate of magnesia entirely absent from a natural water when carbonate of lime was present. I have, as would naturally be expected, found carbonate of magnesia present when the entire lime was present as sulphate.

In examination of a boiler scale, it occasionally happens that the general appearance of a scale is such as would lead the engineer to suspect the presence of a strong bonding agent, such as sulphate of lime, while complete analysis shows the scale to be practically free from sulphates. While the carbonates of lime and magnesia form in presence of organic matter, and especially in high pressure boilers, hard compact scale in many cases, analysis of scale will show that the whole of the bases of these metals cannot be combined with carbonic anhydride. The reason for this is evidently the reducing of part of one of the compounds to an hydro-oxide. Since magnesia is the least stable of the two bases, it is the writer's opinion that the magnesium carbonate immediately in contact with the boiler plate is reduced from a carbonate to an hydrate, and carbonic acid gas liberated. When this occurs in presence of sulphate of lime a particularly obnoxious scale is formed.

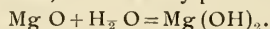
A sample of scale sent to my laboratory of a very troublesome nature, being very hard and tenacious, and having very high power as a non-conductor of heat. While it was, according to sample, less than $\frac{1}{4}$ inch thick, still its construction made it extremely dangerous. Subsequent analysis proved it to have the following composition :

Silica.....	9.66%
Alumina and peroxide of iron.....	3.44%
Sulphate of lime.....	57.37%
Carbonate of magnesia.....	27.12%
Magnesium hydro-oxide.....	2.07%
	99.66%

In this case a portion of the magnesium carbonate through the action of heat had been reduced according to following equation :



the oxide of magnesia thus formed then combining with water to form the hydro-oxide, which is only partially soluble in water.



The hydro-oxide is extremely fine, and under conditions existing within the boiler forms a ready bonding material, and especially so in presence of sulphate of lime.

The carbonates of lime and magnesia when precipitated at such at low temperature, form porous, easily-removed scale, having very low specific heat, consequently cannot be classed as equally dangerous with those scales of more compact construction. Some idea of nature of scale formed can be arrived at from a study of the physical and chemical properties of the following samples of scale analyzed in my laboratory.

The first is a sample of scale formed from water containing salts of both lime and magnesia, and both hard and tenacious, containing the following parts in 100 :

No. 1. Supplied from Montreal, Que :

Silica.....	1.56
Alumina and peroxide of iron.....	4.30
Carbonate of lime.....	26.95
Sulphate of lime.....	52.65
Carbonate of magnesia.....	14.20

No. 2. Sample of scale from New Toronto, Ont.—Shows a rather uncommon condition of scale forming. As seen by composition of scale, a large quantity of mud (greatest portion of which must have been held in mechanical suspension) was present ; this, combined with sulphate of lime, formed a particularly troublesome scale. The composition of impurities in the water from which this scale was formed is illustrated in sample No. 6, last month's issue, and is worthy of remark for two important reasons : First, analysis of water shows very little alumina present, consequently very little mud was held in suspension, while scale shows a large quantity of alumina. This difference is accounted

for by the fact that weather conditions had much to do with the presence of mud, and sample sent for analysis showed water under best possible conditions ; secondly, it will be observed that water contains both carbonates of lime and magnesia, while carbonate of lime is entirely absent from scale. This circumstance at first somewhat puzzled the writer, until he ascertained that the engineer in charge was using refined coal oil to remove scale. As is very often the case, oil contains excess of free sulphuric acid acquired during process of refining in sufficient quantity to reduce the whole of the carbonate of lime to sulphate and also a portion of the carbonate of magnesia to sulphate of magnesia, which latter, being soluble in water, does not appear in the scale.

This sample of scale contains the following parts in 100 :

Silica.....	3.98
Alumina, with traces of peroxide of iron.....	33.80
Sulphate of lime.....	53.52
Carbonate of magnesia.....	8.78

No. 3. Sample of scale from Walkerton, Ont.—Light, porous and easily broken or removed, a typical type of carbonate scale formed at low temperatures. Composition :

Acid insoluble.....	.38
Alumina and peroxide of iron.....	1.10
Carbonate of lime.....	92.08
Carbonate of magnesia.....	5.60

Carbonate in presence of organic matter form in many instances very hard scales, degrees of hardness varying with nature of organic matter present.

No. 4.—Sample No. 4, received from London, Ont., is an excellent type of scale of this kind, being very hard and tenacious. The organic matter present in this case was largely composed of oil, which by action of heat has become carbonized, and although scale was not more than $\frac{1}{4}$ inch thick, it was of a very dangerous type. Composition :

Acid insoluble.....	.70
Alumina and peroxide of iron.....	.75
Sulphate of lime.....	2.33
Carbonate of lime.....	80.07
Carbonate of magnesia.....	9.91
Organic matter.....	6.04
	99.80

Another sample of scale with nearly the same composition, thicker, but much coarser in granular construction, due to difference in nature of organic matter, yielded on analysis :

Acid insoluble.....	.30
Alumina and peroxide of iron.....	.70
Sulphate of lime.....	3.32
Carbonate of lime.....	83.75
Carbonate of magnesia.....	6.20
Organic matter.....	6.01
	100.28

The loss occasioned by allowing such formations as above to remain on the sheets and tubes of a boiler is so important a factor in economy that it is almost impossible to estimate it. It has been stated on good authority that the formation of an incrustation $\frac{1}{16}$ of an inch in thickness will increase the fuel consumption 12% over a boiler working under similar conditions with clean shell and tubes. This statement is, however, obviously in error, since scale of different composition has different heat conducting powers, and loss must vary in accordance with composition of scale, as well as with variation in thickness. The fact remains that the incrustation formed within a boiler has a very much lower conductivity than has the plate of the boiler itself, even under most favorable conditions, so that loss is bound to occur if incrustation is allowed to accumulate ; and loss is not only loss of heat and consequently loss of fuel, but serious damage to boiler may occur. Such is the non-conducting power of many even very thin scales that plates are liable to become over-heated, while scale has a high non-conductivity, when interposed between boiler shell and water it has very low tensile strength ; consequently, when plates become overheated, internal pressure forces the affected part outward, and boiler is badly damaged, even if serious explosion does not occur.

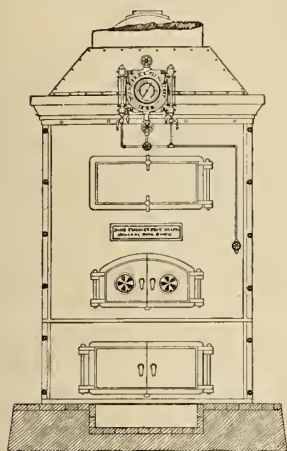
(To be Continued.)

The question of a franchise for electric lighting in Ottawa is still unsettled. It appeared that the offer of the Ottawa Electric Company would be accepted, but it is now proposed to refer the matter back with a view to ascertaining on what terms and conditions the plant and property of the Ottawa Electric Light Company can be acquired by the corporation.

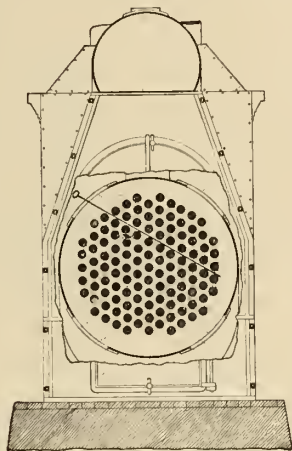
MUMFORD'S IMPROVED BOILER.

ON this page we illustrate a new boiler intended to meet the demand for greater economy and efficiency than are obtained from the ordinary brick set boiler. The water circulation is similar to that of a water tube boiler, and for very high pressure it is built with a corrugated furnace. It was designed by Mr. J. A. Mumford, and is manufactured in Canada by the Robb Engineering Co., of Amherst, N. S., and in the United States by a large concern in Erie, Pa.

The furnace has ample room for mixing the gases



FRONT VIEW OF MUMFORD'S IMPROVED BOILER.



END ELEVATION OF MUMFORD'S IMPROVED BOILER.

and is surrounded by water, so that the direct and radiant heat of the fire is readily absorbed. The heated gases pass directly through well proportioned tubes and return around the shell of the boiler and underneath the drum, making every square foot of the boiler effective as heating surface, and enter the smoke stack with sufficient temperature remaining to produce good natural draft. By covering the case and drum with a non-conducting material the loss of heat usually found in the setting of boilers may be reduced to a minimum.

The water circulates continuously from the front to the back of the boiler, up the back connection to the drum, where the steam freely separates from the water, and down the front connection to a point below the fire. This positive circulation admits of using forced draft, increasing the horse power of the boiler without foaming or priming, the increased temperature increasing the speed of the water circulation without any evil effects.

Special arrangements are made to avoid trouble with bad water. The feed pipe enters the drum near the back end, and part of the sediment is deposited in a settling chamber at the front end of drum and may be blown out. Additional impurities that are carried down the front connection are deposited in another settling chamber below the furnace. This leaves very little, if any, impurity to form scale on the furnace and tubes, and it may be removed by a scraper inserted through hand holes in the shell, the tubes being spaced so that all can be cleaned. Doors are placed in the casing opposite these hand holes, which also give facilities for cleaning the outside of the shell.

The Robb Engineering Company inform us that they have already installed two of these boilers in Montreal and others in Lethbridge, Fort William, Ont., Parrsboro, N. S., while a number more are ordered.

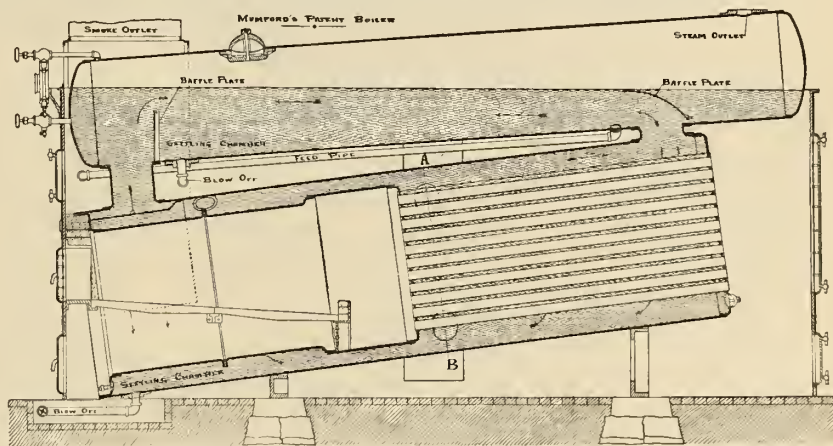
FIFTY THOUSAND VOLT TRANSMISSION.

IT is a fact not generally known, says the Electrical Engineer, that a transmission of 50,000 volts was some time ago tried for a period of two weeks from the water power plant at Telluride, Col., to the Gold King stamping mills there. The Telluride transmission is well known as one of the earliest in this country. The first plant consisted of a single-phase 3,000-volt alternator with direct transmission to a synchronous motor three miles away. This has since been replaced by a three-phase transmission, with step-up and step-down transformers. It was about the time that the change was made that the experiment was tried of transmitting at 50,000 volts three-phase alternating current. The transformers used were those now employed on the three-phase transmission there, said transformers being arranged to give a number of different voltages from 50,000 down according to the way they were connected:

As said before, this transmission at 50,000 volts three-phase current was kept in service for about two weeks, and no accidents occurred during the time. The line consisted of galvanized iron telegraph wires supported on glass insulators. It was found that the self-induction afforded by the iron wire had a beneficial effect in counteracting the capacity of the line. The experiment was not continued for a longer time because a rainy season came on and proper provisions against lightning were not at hand. The transmission line is three miles long, and runs up a steep mountain-side and over a very wild country.

PURE WATER AND NEW BOILERS.

THE corrosive powers of pure water on new or unscaled boilers was illustrated in the city of Glasgow when a new water supply was introduced from Loch Katrine, one of the purest waters in the world which are available for city consumption. The former supply had been poor and calcreous, and old boilers were



SECTIONAL VIEW OF MUMFORD'S IMPROVED BOILER.

much coated with lime scale. To the dismay of the users those who had put in new boilers or new tubes found them rapidly corroding, while the old scaled and coated boilers remained as before. Those, too, who had removed every possible trace of old incrustation from their old boilers by mechanical means, intending thus to get, as they expected, the full benefit of pure water, were also badly troubled by corrosion, and even the old boilers, as the scale was gradually removed by the unvarying soft and pure water from the lake, were more or less corroded when no means were taken to prevent it.

THE NORTHEY GAS ENGINE.

OF late years the gas engine has attracted considerable attention as a motive power, and although we do not predict that the day of steam engines is passing away, the fact cannot be disputed that for certain work the gas engine has some points in its favor. As to the efficiency of the gas engine in comparison with steam, we are not prepared to talk up the cudgels in favor of the former, but it can safely be said that it occupies small space, removes the necessity of handling bulky fuel, produces no ashes, dirt or refuse, and requires but a very little water supply.

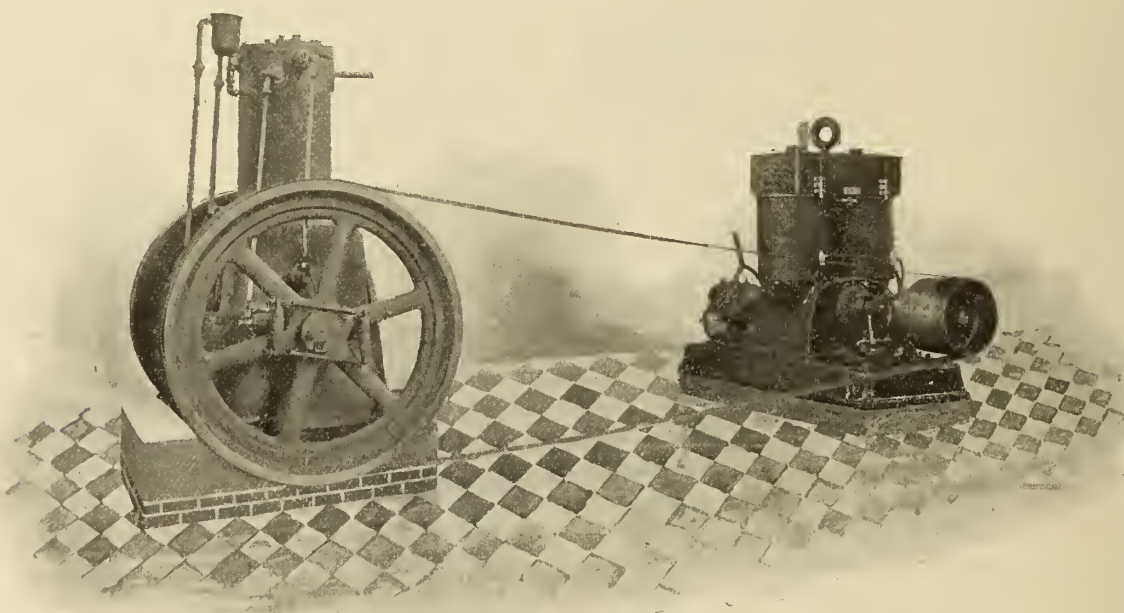
The Northey Manufacturing Company, of Toronto, have for some time been manufacturing a gas and gasoline engine, for which they report a growing demand, chiefly for engines of from 4 to 6 horse power. The accompanying illustration shows a gasoline engine belted to a dynamo. The details of construction of the engine, as given by the manufacturers, are as follows: It consists, broadly speaking, of a base, cylinder, piston, connecting rod, crank shaft, fly wheels and valve gear. The base and cylinder are substantial castings of proper

engine is running light the charge is cut off to what is necessary only to keep engine up to speed, and if engine reaches a few revolutions over the regular speed, the charge is cut off altogether, and thus there is no possibility of engine running away.

The arrangements for keeping the engine from becoming overheated are very complete; a heavy galvanized iron tank is supplied with each engine, to hold water sufficient to keep engine at proper temperature. The water is circulated through this tank by the heat of the engine cylinder, the warmer water going to top of tank, and the cooler portion coming from bottom.

All engines are fitted with electric or incandescent tube igniter. The electric igniter has a positive motion, giving a wiping contact above and below a small wire electrode, which can be replaced from outside of engine in the simplest manner. A battery of eight cells furnishes the small amount of current needed, and is maintained at a very low cost.

The gasoline supply is stored in a heavy galvanized iron tank, which is placed outside the building, and connection made direct from tank to engine by $\frac{1}{4}$ or $\frac{3}{8}$



NORTHEY GAS ENGINE DRIVING DYNAMO.

weight to insure durability and freedom from vibration, and are made of high-grade cast iron. The piston is very long to give large wearing surface, and is made of special iron, fitted with spring rings. The connecting rod is fitted with a phosphor bronze bearing at upper or wrist pin end, so arranged as to take up wear easily. The other end is fitted with babbitted boxes of the marine type. The crank shaft is of steel, finished to gauge. The valves are of the poppet type, and lift squarely off their seats without friction. The valve gear is enclosed in an iron housing absolutely dust and grit proof, and runs constantly in oil, thus insuring perfect lubrication and great durability.

The engine is fitted with two fly-wheels, which is claimed to be the only method which puts equal wear on both bearings. If only one fly-wheel is used the bearings must wear unevenly, as the box on the fly-wheel side wears downward, and the box on the opposite side upward.

The irregular speed, such as is met with in most governors, is overcome by a graduated charge governor, which controls the amount of the charge admitted to the cylinder in proportion to the work being done, and allows the engine to use only what is actually needed. If

inch pipe. A small and very simple pump on base of engine draws the gasoline from tank and delivers it to engine cylinder, so that at no time is the gasoline exposed to the action of the outer air.

The gas engine is claimed to be specially adapted for electric lighting, the graduated charge governor ensuring the even, steady speed indispensable for such work. Small plants installed in opera houses, buildings, mines, etc., are said to show a great economy over the use of gas for illuminating purposes, as if the gas is used in the engine for motive power, it will produce twice the light in incandescent lamps, and if arc lights are used the difference is still greater in favor of the gas engine.

As to the cost of operation, it is guaranteed that the consumption of gas will not exceed from 18 to 22 feet, or one-tenth of a gallon of 74 degrees gasoline, for each horse power produced per hour. With gas at 90 cents per 1,000 feet, the cost would be about 18 cents per horse power for ten hours work.

The Northey Manufacturing Company will gladly furnish any further particulars desired by interested persons.

RECENT CANADIAN PATENTS.

A PATENT has been granted to Mr. John Sharp, of Gravenhurst, Ont., for a water wheel, as shown by the accompanying cut. The claim is for a wheel secured to a vertically journalled shaft, and a series of radial buckets inclined from the vertical at substantially an angle of forty-five degrees, and secured to the rim, in combination with a frame surrounding the buckets, a cover therefor provided with a series of openings, each extending over two or more buckets, and a curved conductor connected with each of the said openings and with a source of water supply, the arms in the conductors being such as to discharge the water at substantially a right angle to the surfaces of the buckets; a curved conductor connected with each of above said openings, a tank with which

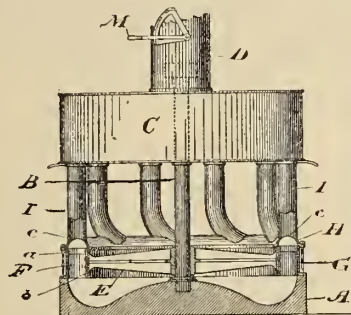


Fig. 1.

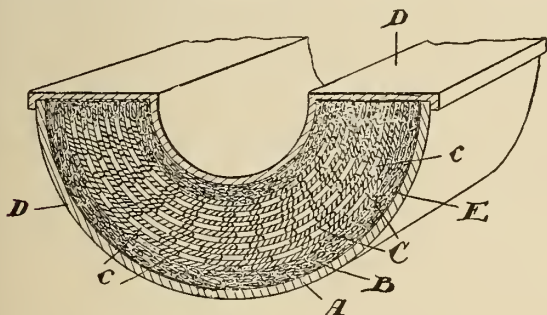


Fig. 2.

TURBINE WATER WHEEL.

the said conductors are connected, a flume connected with the tank, a cut-off valve in the said flume, and a cut-off valve for each conductor, substantially as set forth.

Mr. Henry C. Mitchell, Toronto, has obtained a Canadian patent, No. 58,788, for a pipe and boiler covering, as herewith illustrated. It is claimed to be a non-conducting covering, comprising concentrically arranged flakes or laminae of mica, forming multitudinous hollow non-communicating interspaces and a suitable binding medium permeating the outer portion of the layers and forming at the inner an irregularly formed surface, whereby the covering is held in shape and position, etc. A method of forming a non-conducting covering for boilers and the like, consisting in spreading upon suitable backings for the outer and inner portions of the covering, a composition comprising a damp or wet binding medium, intermixed with mica particles, superimposing upon the



PIPE AND BOILER COVERING.

outer portion the concentric flakes or laminae of mica, placing the inner and outer portions together to enclose the central laminae, and finally subjecting the whole to a suitable drying process whereby the binding medium is hardened and permeates into the mass, as and for the purpose specified.

NEW CABLE ACROSS THE GULF OF GEORGIA.

THE C. P. R. recently completed the laying of a new cable across the Straits of Georgia, from Vancouver, B. C., to Departure Bay, on Vancouver Island. The distance, as the crow flies, is about 32 miles, but it was found that the bed of the gulf was broken up by innumerable hills, mountains and gulleys, nearly 8 miles of wire being used in covering this irregular space, making the cable 40 miles in length.

The cable was made by the Telegraph Construction and Maintenance Company, of London, Eng. It weighs about 320 tons, and its total length when it left the manufacturers was 45 miles. Some idea of the difficulty experienced in handling it may be had from the fact that it took the crew of the Tartar two days and a half to get it on board at Southampton. The duty on the cable was \$10,000, and by the time the company received it in Vancouver it cost them considerably over \$50,000. In diameter the cable is slightly more than an inch and a half, and it contains three wires or cores, which provide three distinct services or connections. Each of these cores is about the size of a lead pencil, and each contains fine copper wires packed in jute and insulating material. Inside of this they are armored with 14 galvanized steel wires,

wound spirally. Inside of this again is the final covering of tarred jute canvas.

The old cable which it replaced was a single core, or single wire, and was laid in March, 1881. Since that time it has been broken several times, and has given much trouble.

From shore to shore the cable was laid almost without a hitch, the steamship Tartar being employed. The receptacle for the cable was a steel tank about 35 feet in diameter and 12 feet high. In the centre was a circular spool-like frame, around which the cable was coiled. The work was carried out under the supervision of Mr. F. B. Gerrard, assistant superintendent of the Commercial Cable Co., of Canso, N.S., and Mr. J. W. Wilson, superintendent of C.P.R. telegraphs in Vancouver.

PERSONAL.

The death is announced on the 22nd ultimo, at his residence in Toronto, of Mr. Benjamin W. Stokes, late engineer and electrician at Centre Island, in his 43rd year.

Mr. J. A. Kammerer, of the Royal Electric Company, has returned from Atlantic City, so far improved in health as to be able to put in part time at his office. He is steadily gaining strength, and, assisted by the returning warm weather, will no doubt soon be entirely himself again.

Mr. P. A. Dickson died at Brantford, Ont., on April 25th, at the age of 40 years. Deceased was for a number of years electrician for the Brantford Electric Power Company, leaving there last summer for British Columbia, where he contracted a severe cold, which resulted in his death.

Much regret is felt at the removal to England of Prof. Carus-Wilson, of the Engineering Department of McGill University. Prof. Wilson sailed with his family from New York on the Campania on April 23rd, and on arrival in England will reside at Hanover Lodge, Kensington Park, London, W.

Professor H. L. Callendar, of the Physics Faculty of McGill University, has received the appointment to the chair of Physics at University College, London, England. Prof. Callendar's work at McGill has been greatly appreciated, and general regret is expressed at his forthcoming departure. The results of some interesting experiments on the condensation of steam conducted by him appeared in our April issue.

Mr. W. J. Green, who for many years has occupied the position of local agent for the Canadian Express Co., Bell Telephone Co., and Grand Trunk Railway Co., at Walkerton, Ont., has recently removed to Berlin, where he will fill the position of local manager for the Bell Telephone Co. Before leaving Walkerton Mr. Green was presented by the Mayor, on behalf of the citizens, with a handsome gold watch, and Mrs. Green with a beautiful chair, accompanied by an address expressive of the good wishes of the community. Mr. Green was also presented on behalf of the Masonic fraternity with a past master's jewel. The people of Berlin will require from Mr. Green no better recommendation than the spontaneous expressions of esteem bestowed upon him by those who best know his worth.

Mr. L. A. Campbell has been appointed manager of the West Kootenay Power & Light Company, and has left for British Columbia to take up his new duties. Mr. Campbell has had an extensive experience in electrical work, having been connected with the Fort Wayne and Edison General Electric Companies in the early days of the industry in Canada. Since the formation of the Canadian General Electric Company he has been employed on the construction and engineering staff of that company, and, on the departure of Mr. W. Rutherford, chief engineer of the company, for England, eighteen months ago, succeeded him in that position. The installation of the West Kootenay Power Company's plant has been carried on under Mr. Campbell's personal supervision; he is therefore thoroughly acquainted with the conditions under which it can be most favorably operated, and his selection to fill the position of manager is a very fortunate one for the company. His many friends in the electrical business in the east will join in wishing him the best possible success in his new field of labor.

TRADE NOTES.

James Pender & Co., St. John, N.B., have put in a new 15 h.p. Goldie & McCulloch engine.

A. Bobson, Esq., Beaverton, has purchased a 400 light incandescent dynamo from the Canadian General Electric Company.

Mr. T. E. McLellan, manager of the Berlin and Waterloo Street Railway, has resigned his position to go to the Klondyke, and will be succeeded by Mr. H. Hilborn, of Montreal.

The British Columbia Iron Works Co. have ordered a 6 kilowatt incandescent dynamo from the Canadian General Electric Co. for a steamer which they are building for the Klondyke trade.

The Jones & Moore Electric Company, of Toronto, have just installed a lighting plant on the steamer "Northern Belle," comprising 80 16 c.p. lights, and fitted with marble switchboard and first class instruments. The work was done at Collingwood, the installing expert being Mr. J. H. Ward.

The Hudson Bay Company have placed a contract with the Canadian General Electric Co. for two 100 light incandescent equipments, to go on their new steamers, running from Vancouver and Victoria to the Stickeen river.

The Eugene F. Phillips Electrical Works, Montreal, have been given the contract to supply all the trolley, bond and feed wire required in the construction of 25 miles of electric railway at Jamaica, West Indies. This is the new road with which Mr. Holgate, formerly manager of the Montreal Park and Island Railway, is connected.

EDUCATIONAL DEPARTMENT

INTRODUCTORY

After mature deliberation the publisher of this journal has decided to devote a certain amount of space each month to what may be termed an Educational Department, wherein both mechanical and electrical formula and mathematical problems will be discussed, illustrated, and as far as possible rule and example given. At the request of the editor, I have with pleasure undertaken to contribute to this department regularly each month, and before discussing actual mathematical problems, wish to briefly introduce the subject at issue.

The primary object of this department is chiefly to increase the value of an already valuable paper, by placing in the hands of every engineer who has any knowledge of the rudimentary principles of mathematics, such matter as will enable him by a little study to master the most intricate mechanical and electrical formula. Many of our most valuable engineering works and publications from time to time contain formula that is in many cases but vaguely understood, and very often entirely misunderstood, thus rendering an otherwise valuable work practically valueless to the reader.

Just at what particular point our calculations should commence became a matter of serious thought, and past experience had to be carefully considered, bearing in mind the fact that there are many really good engineers whose early education has, through force of circumstances, been deficient, and many others who, through lack of opportunity, have not been able to review their early education for years. Knowing by observation and experience the great necessity of having a thorough elementary education before attempting to digest and calculate problems, and the almost utter impossibility of the student arriving at a satisfactory conclusion of his studies without a thorough knowledge of the principle of mathematics involved, I have decided to commence at a point and carry out the programme outlined in this journal—commencing at the foundation and advancing by easy stages until the principles underlying the most obtuse and difficult formula can be readily explained and easily understood. The advantages to be derived from an education of this kind, coupled with practical mechanical ability, is too well understood to require comment.

The programme which has been outlined for the succeeding nine months will embrace:

DECIMAL FRACTIONS—Definitions and explanation of principles of, and method of reduction to common fractions, and vice versa.

SQUARE AND CIRCULAR MEASURE—Definition and explanation and practical demonstrations of.

CUBICAL AND CYLINDRICAL MEASUREMENTS—Definitions and explanations of, with practical hints.

SQUARE AND CUBE ROOT—Definitions and explanations of.

SAFETY VALVE CALCULATIONS—(Spring and Lever Types)—Principles of, with practical demonstrations.

BOILER CONSTRUCTION—Stays, rivets, joints and seams, iron and steel plate—strength of, with formula and practical demonstrations.

It is not the intention to fill these columns with a mass of figures hastily compiled without reference to any particular object; on the contrary, every problem will be carefully thought out, and only such information given as will be of use to you, and an effort will be made, based on experience and a knowledge of the requirements, to make his series of tests complete in every particular.

WM. THOMPSON.

THREE-WIRE SYSTEM.

In the three-wire system the lamps are really arranged in sets of two in series. The two outer wires have double the potential of the lamps, and since, owing to the lamps being in series, one-half the current only is required as compared with multiple arc two-wire system; therefore, to carry one-half the current with twice the difference in potential or double the E.M.F., a conductor with one-quarter the area of cross-section suffices.

Dynamos are frequently set in series in large buildings, and their terminals wired out on the three-wire system to save copper. Since each of the wires is but one-quarter the size of the wires in the ordinary two-wire system, it remains clear that the weight of copper required on the three-wire system is but $\frac{3}{8}$ of that required on ordinary two-wire systems. The formulæ already laid down for two-wire work apply to three-wire calculations as regards size of mains, if denominator of formula be multiplied by 4.

$$C M \text{ or } d^2 = \frac{21.58 \times L N \times (100 - \%)}{R \times \% \times 4}$$

This formula gives required cross-section of mains in circular mils, using commercial copper wire as a conductor.

ALTERNATING CURRENT SYSTEM.

In alternating systems we have two sets of mains to deal with, primary and secondary, both of which have different E. M. F.'s.

Theoretically, the rules deduced from Ohm's law are not correct as applying to this system of generation, because calculations must be made to allow for conversion from primary to secondary current. The ratio that the primary E.M.F. bears to the secondary E.M.F. is expressed by dividing the primary E.M.F. by the secondary E.M.F., and is termed ratio of conversion. Thus,

$$\frac{E \text{ primary}}{E \text{ secondary}} = \text{Ratio of Conversion.}$$

The current in the primary is equal to the current in the secondary divided by the ratio of conversion.

Example: On an alternating circuit whose primary E.M.F. is 1,000 volts and secondary E.M.F. 50 volts, there are 500 lamps, each having a resistance of 50 ohms, what is the primary current and what the secondary?

$$\frac{1,000}{50} = 20, \text{ ratio of conversion.}$$

$$\frac{50}{50} = .1, \text{ combined R of lamps.}$$

$$\frac{50}{50} = 500 \text{ amperes current on secondary.}$$

$$\frac{500}{20} = 25 \text{ amperes current on primary.}$$

Current being determined, rules deduced from Ohm's law apply exactly as shown for direct current calculations.

Example: An alternating generator has 4,000 feet of primary main attached with an E.M.F. across the terminals of the machine of 1040 volts; it is decided to allow a drop of 40 volts on the primary at the convertor. The secondary main has attached to it 750 16 c.p. lamps at an E.M.F. of 50 volts, each lamp having a resistance of 50 ohms. What is the resistance on the primary wire?

$$1040 - 40 = \frac{1,000}{20} = 20, \text{ ratio conversion.}$$

$$\frac{50}{50} = 1 \text{ amp., current each lamp.}$$

$$750 \times 1 = 750 \text{ amps., total current on secondary.}$$

$$750 \div 20 = 37.5 \text{ amps. current on primary.}$$

$$\frac{1}{37.5} \times 40 = 1.06 \text{ ohms resistance on primary.}$$

To obtain the required size of primary mains in circular mils,

calculate by formula for two-wire direct current, and divide the result by the square of the ratio of conversion. Or

$$C M = \frac{21.58 \times L N \times (100 - \%)}{R \times \% \times R C^2}$$

Example: An alternating current generator has an E.M.F. across the leads of 1040 volts, and current is delivered 4,000 feet from station, E.M.F. at terminals being 1,000 volts; current consists of 1,000 lamps, having a resistance of 50 ohms each on a 50 volt secondary circuit. What should be the cross-section of the primary mains in circular mils, and what is resistance of same main to allow a drop of 40 volts as shown?

$$\frac{1000}{50} = \text{E.M.F. at terminals of primary} = 20 \text{ R.C.}$$

$$40 \div 1040 = 3.84\% \text{ drop in potential.}$$

$$\frac{21.58 \times 4000 \times 1000 \times (100 - 3.84)}{50 \times 3.84 \times 20^2} = 108,079 \text{ C.M., required cross-section of primary main in circular mils.}$$

$$\text{Total current on secondary} = 1000 \times \frac{50}{50} = 1000 \text{ amps.}$$

$$\frac{1000}{20} = 50 \text{ amps. secondary current.}$$

$$\frac{1}{50} \times 40 = .8 \text{ ohms resistance, primary main.}$$

HORSE POWER CALCULATIONS.

The power or force required to do a certain mechanical work is usually referred to as foot pounds. That is, one pound raised one foot high is called a foot pound, without reference to the time required to do the work. Therefore, if we want to find force or energy required to be expended to do a certain work expressed in foot pounds, we require to multiply the weight required to be raised by the distance in feet through which weight has to be lifted.

A horse power is fixed as the work performed in raising 33,000 pounds one foot high in one minute, or what is exactly the same thing, raising one pound 33,000 feet high in the same period of time. Here we have time required to do a certain work, and note of this must be taken in our calculations.

Then to reduce force exerted at the piston of a steam engine, and to express this force in horse power, we require to know effective pressure against the piston throughout the stroke, and distance travelled in feet by the piston per minute. And to do this use the following established rules:

1st. Find area of piston in square inches.

2nd. Find the total pressure in pounds on the piston by multiplying the area by the mean effective pressure per square inch.

3rd. Find the distance in feet traversed by the piston per minute by multiplying the length of stroke in feet by twice the revolutions per minute.

4th. Find the energy exerted by the engine expressed in foot pounds per minute by multiplying the total pressure in pounds against the piston by the travel in feet per minute.

5th. Find the horse power by dividing total foot pounds per minute by 33,000.

From this, then, we can construct the following simple formula:

$$\frac{A \cdot N \cdot P \cdot S^1}{33,000} = H.P.$$

Where A = Area of piston in square inches.

N = Number of strokes per minute (revolutions multiplied by two.)

P = Mean effective pressure per square inch.

S¹ = Length of stroke in feet.

Example : Find the horse power of an engine 9.5 inches by 12, running 280 revolutions per minute, mean effective pressure throughout the stroke being 35 pounds per square inch.

$$9.5^2 \times .7854 = 70.88 \text{ square inches area.}$$

$$\begin{array}{r} 70.88 \times 35 = \\ 70.88 \end{array}$$

$$\begin{array}{r} 35440 \\ 21264 \end{array}$$

2480.80 total pressure against piston.

280 revolutions per minute.
2 strokes per revolution.

560 strokes per minute.
1 length of stroke in feet.

560 feet travelled by piston per minute.

2480.8 pressure on piston.

$$\begin{array}{r} 560 \\ 1488480 \\ 124040 \end{array}$$

1389248.0 foot pounds per minute.

33000)1389248. (42.09 horse power.

$$\begin{array}{r} 132000 \\ 69248 \\ 66000 \\ 324800 \end{array}$$

We have in this formula two constants, .7854 constant multiplier to find area, and 33000 constant divisor to find horse power, consequently by dividing .7854 by 33,000 we get a constant multiplier as a result, and thus shorten our method.

.7854 ÷ 33000 = .0000238, which becomes a constant multiplier, and our formula then becomes (d² N P S¹) × .0000238 = H. P.

Example: Using this formula find horse power of an engine, dimensions, etc., as per last example.

9.5 = diameter of piston.

$$\begin{array}{r} 9.5 \\ 90.25 = d^2 \end{array}$$

560 = strokes per minute.

$$\begin{array}{r} 541500 \\ 45125 \end{array}$$

$$\begin{array}{r} 50540.00 \end{array}$$

35 = mean effective pressure.

$$\begin{array}{r} 252700 \\ 151620 \end{array}$$

$$\begin{array}{r} 1768900 \end{array}$$

.0000238 = constant multiplier.

$$\begin{array}{r} 14151200 \\ 5306700 \end{array}$$

$$\begin{array}{r} 3537800 \end{array}$$

$$\begin{array}{r} 42.0998200 = \text{H.P.} \end{array}$$

CALCULATING HORSE POWER FROM INDICATOR DIAGRAMS.

An indicator diagram is practically a record of the action of the steam on the piston throughout the stroke of an engine, and if we are enabled to ascertain the area of the diagram, having the length of the diagram and scale of spring used before us, it becomes an easy task to find the mean effective pressure of the steam throughout the stroke.

The area of the diagram is easiest found by use of a small instrument called a planimeter, which should be set to a natural scale, that is, area of diagram should read in square inches. Knowing the area and dividing by length of diagram in inches, will give us height of a regular body of an equal area.

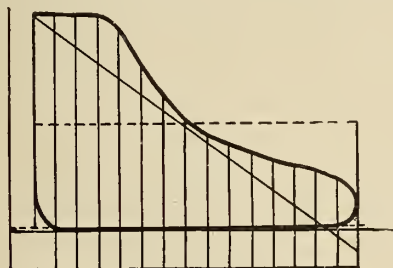


FIG. 7.

Fig 7 represents a diagram 3 inches in length, and the irregular body has an area of three square inches. If we reduce this area to a regular body with at least two of its sides equal, we get a diagram, as shown by dotted lines, exactly one inch in height; multiplying this by scale of spring used, we get M.E.P. throughout the stroke. Therefore, we can construct a formula as follows to calculate M.E.P. from an indicator diagram :

$$\text{Area} \div \text{Length} \times \text{Scale of spring} = \text{M.E.P.}$$

The horse power calculation can be very much shortened by using what is known as an engine constant; that is, the power developed by an engine with M.E.P. of 1 pound per sq. inch, and is particularly useful where horse power calculations are being constantly made from same engine.

Abbreviated the formula would then read :

$$\text{Engine constant} \times \text{M.E.P.} = \text{H.P.}$$

Example : Using engine constant and M.E.P. find I.H.P. of a single cylinder engine 9 1/2" x 12" running 280 revolutions per minute. Diagram measures 3 inches in length, and planimeter

shows area to be 2.625 sq. inches, scale of spring used in indicator being 40 pounds per inch of compression.

First, find power developed by engine with a mean effective pressure of one pound per square inch :

$$9.5^2 = 90.25$$

$$90.25 \times 560 = 50540$$

$$50540 \times .0000238 = 1.2 \text{ H.P.}$$

Then power developed by this engine with steam pressure on piston equalling one pound per square inch of area is 1.2 H.P., which is our engine constant. Next find mean effective pressure shown by diagram :

$$\text{Area} \div \text{Length} = 2.625 \div 3 = .875 \text{ average height in inches.}$$

$$.875 \times 40 \text{ scale of spring used} = 35. \text{ M.E.P.}$$

Then

$$1.2 \times 35 = 42. \text{ horse power.}$$

In the absence of a planimeter, it becomes necessary to devise a method of arriving at area of diagram. To those engineers who

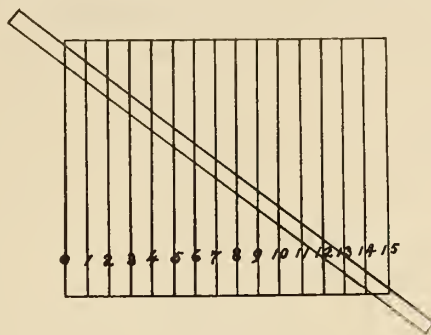


FIG. 8.

are unacquainted with geometry this is sometimes difficult to do.

With every indicator is sent out a number of rules graduated in such a manner that the divisions between each inch correspond exactly with scale of spring used; by the aid of these it becomes comparatively easy to subdivide into equal divisions. For instance, suppose we wish to divide Fig. 7 into 15 equal parts by using a graduated scale laid across diagram at an angle so that the divisions 1 and 15 shall exactly coincide with lines at each end of diagram, and marking off at each division on scale intervening by erecting at each of these points an ordinate at right angles with atmospheric line, we get 15 exact divisions. It now remains for us to ascertain the pressure represented in the centre of each of these divisions, and finding the mean pressure by adding the pressures together and by dividing the total by number of ordinates erected, we get total mean effective pressure calculation of H.P. It then becomes a simple repetition of examples already described. To convey meaning clearly Fig. 7 is reproduced in Fig. 8.

[THE END.]

SUPERIOR BOILER COMPOUNDS.

THE advertising pages of this issue contain the announcement of the Canadian Chemical Compound Company, and as this company is probably unknown to some of our readers, being of recent organization, a few words of introduction may here be given. The personnel comprises Messrs. A. M. Wickens, E. J. Philip and D. J. LeRoy. The headquarters of the company are in the Temple Building, Toronto, where nicely fitted and convenient offices have been secured; while the Montreal office is located in the Street Railway Chambers. The factory is at 66 River St., Toronto.

As implied by the name, the company are manufacturers of chemical compounds for boilers, and being composed of thoroughly practical men, it is not to be wondered at that they are producing an article second to none in the market. The manufacture of the compound is under the supervision of Messrs. Wickens and Philip, who have given the matter very careful study for some time past, while Mr. LeRoy has charge of the sales department. From a neat booklet just issued, we learn that the company have made a somewhat new departure, in that they are manufacturing three distinct brands to meet the necessities of different waters, this step being determined upon after making a large number of analysis of various waters used in Canada.

Their "Canadian" brand is suitable for the water in our Great Lakes, and all waters of a like quality. It is claimed to prevent internal pitting and corrosion of the boiler and all apparatus it passes through. Their "Automatic" brand is specially prepared for waters carrying heavier and harder sulphates, such as some of the river waters and some spring well waters. This brand is more active than the "Canadian," and is exceptionally good for water tube and other rapid steaming boilers used under hard and continuous firing. Their "Zinkolene" is said to be the outcome of a large number of carefully conducted tests with the most difficult waters in Canada, and will, it is said, succeed where all others fail. It is sharp and active and must be used according to special directions sent with each package, which are not sent to allay its sharpness, but to assist it in the loosening of very hard and difficult scale.

The compounds made by this company are liquid and purely vegetable, containing no acids or other injurious material, and are readily fed into the boilers. They are the results of years of experience by a practical engineer, assisted by a first-class chemist.

To show the importance of steam users looking to the prevention of boiler scale, it is estimated by eminent engineers and fully borne out by actual experience that 1/16 inch of scale causes a loss of 13% of fuel, 1/4 inch 38% and 1/2 inch 60%. The best of waters for steam boilers contains about 8 grains of scale-making properties per gallon.

ELECTRIC RAILWAY DEPARTMENT.

THE HAMILTON STREET RAILWAY.

THE Hamilton Street Railway Company recently made application to the City Council for an amendment of the present agreement with the city under which the company has to pay over \$13,000 a year for percentage and mileage. A meeting of the Finance Committee was held on April 4th to consider the matter. The company's solicitor presented figures which showed that there had been a falling off in receipts last year, and that no dividends had been paid since 1895. He attributed the falling off in receipts to the building of the radial railways, which cut into the local business, and stated that at the present time the company could not operate under the conditions. He proposed that the by-law should be amended to provide for the removal of snow from the track; the company to sell nine instead of eight limited tickets for 25 cents, and to extend the time from 6.30 a. m. to 8 a. m., 11.50 a. m. to 1.30 p. m., and 5 to 6.30 p. m.; to carry children between 5 and 12 years of age for 3 cents, or sell ten children's tickets for 25 cents; also to allow its tracks to be used by radial railways entering the city on terms to be agreed upon. In lieu of these conditions the company asked that the franchise be extended to 1928, the mileage abolished, and the percentage be rearranged as follows: Receipts up to \$200,000, 5 per cent.; receipts over \$200,000, 8 per cent. Mr. Martin also submitted an alternative proposition to abolish mileages and percentages, and after paying expenses, etc., to equally divide the surplus between the city and the company until each receive \$10,000 a year, then the city to receive the percentages under the by-law, the franchise to be extended to 1928, and radial railways to be allowed to use the company's tracks on the terms to be agreed to.

The Finance Committee submitted several questions to the company, which were answered in the following words: "The actual cost of the Hamilton Street Railway is represented by the capital paid up in cash, \$204,704.40, and the bonds issued in 1894, \$500,000; total, \$704,704.40. The company's charter does not permit it to sell the railway, nor can the company control the shares of the shareholders, or bind the bondholders to agree to a sale, neither has the city power to purchase the railway. Very special legislation would, therefore, be required to enable such a purchase to be made, and it would take almost two years to obtain such legislation and pass the necessary by-laws. If the city decides to purchase the railway, and will now make a definite offer which the company can recommend to its shareholders, with a view to obtaining their assent to applying for the necessary legislation, the company will take that step, provided the interests of the company are properly safeguarded in the meantime by the franchise being extended till 1928 substantially upon the terms of the draft by-law now submitted (or the alternative offer), it being further provided that the city shall have the option to purchase out the company at the agreed price within, say, two years, should the requisite legislation and authority have been obtained in the meantime."

Some of the members of the Council are in favor of the city acquiring the railway, but there is a great difference of opinion as to the wisdom of municipal ownership, and the matter has been laid over for further consideration.

The Canadian General Electric Co. have closed a contract with the owners of the War Eagle mine, Rossland, B. C., for the electrical apparatus for operating a compressor plant and elevator.

A survey is being made for a short line of railway from Flower Station, Ont., to the mines of the Hamilton Smelting Company, Andrew Bell, C. E., of Almonte, having charge of the work. It may be an electric road.

The Halifax Tramway Company have recently finished the installation of a second 5000 light monocyclic alternator, which they are installing for their electric lighting service. This makes a total of 16,000 lights capacity in monocyclic apparatus installed by the Canadian General Electric Company in Halifax.

SPARKS.

The Vankleek Hill Electric Company, Limited, has been incorporated, with a capital of \$15,000.

The Metropolitan Railway have placed an order with the Canadian General Electric Company for three additional G. E. 1,000 equipments.

The Canadian General Electric Company are installing a 110 kilowatt direct current railway generator for the Longue Pointe Asylum, Quebec.

Francis Lapointe, of Montreal, is promoting a scheme to build a bridge over the Lachine canal, to be operated by two electric motors of 50 horse power each.

The corporation of Port Arthur, Ont., have purchased a motor car complete with G. E. 1000 motors from the Canadian General Electric Company.

The annual meeting of the shareholders of the City of Birmingham Tramways was held last month, at which a dividend of 5 per cent. was declared and £33,000 carried to the reserve. Mr. Jas. Ross, of Montreal, presided.

The Manitoba Gas & Electric Company have ordered from the Canadian General Electric Company all the apparatus required for their new plant, including a 6000 light direct connected single phase alternator, and a 125 light Brush arc machine.

The Hamilton Radial Electric Railway Company have elected directors for the ensuing year as follows: A. Turner, President; W. A. Wood, Vice-President; John Moodie, Treasurer; Stuart Malloch, Secretary; James Dickson, Adam Zimmerman.

At a recent meeting of the Board of Canadian Underwriters, the best method of securing proper insulation of electric wires was discussed and various suggestions made. In Western Ontario there is an inspection, but in Eastern Ontario and Quebec there is none. A committee was appointed to report at the June meeting.

Mr. J. R. Scott, of Napanee, has placed the order for electrical apparatus for his transmission plant with the Canadian General Electric Company. The generator will have a capacity of 100 kilowatts and will be of the revolving field type, with stationary armature, wound for 4000 volts, three phase. The distance from the generating station to Napanee is 8 miles.

It is announced that the Chinese government has decided to construct an electric tramway to Peking, the contract being given to the Japanese branch of the German firm, Siemens & Halske. An engineer will be despatched by Siemens & Halske, of the Tokio branch, to supervise the work. The electric tramway will run from the terminus of the government railway to the wall of Peking.

The city engineer of Toronto has been negotiating with a company of Buffalo capitalists for the transmission of power to Toronto. The company offer to supply electric energy at \$40 per horse power per year if the city guarantees that it will use 10,000 horse power. The company purposes to operate from a point 30 miles nearer Toronto than the Falls. The city could scarcely guarantee to take that amount of power.

Mr. Elisha Moore, of Meductic, York county, N. B., has invented an alternating switch for street railways, which can be operated from the car by simply pressing a button. The device obviates the necessity of stopping the car and does away with switchmen, which means a great saving to railway companies. Mr. Moore has had his device patented both in Canada and the United States, and will ask for European patents.

The shareholders of the Hamilton, Grimsby and Beamsville railway held their quarterly meeting recently. The quarterly financial statement, as presented by Superintendent Nelles, showed an increase of 10 per cent. in gross earnings over those of the corresponding period of last year. The directors were empowered to issue debentures to pay off the floating debt of \$20,000. The present debenture debt of the road is \$85,000, payable in thirty years.

A special general meeting of the shareholders of the Quebec, Montmorency and Charlevoix Railway Company will be held in Quebec on May 14th, when the following matters will be considered: The acquisition of the franchise and property of the Quebec District Railway Company; the conversion of the existing line of the company between Quebec and Cape Tourmente into a line operated either in whole or in part by electricity; the construction of a branch line from Quebec to the west side of the Falls of Montmorency, operated by electricity.

The appeals of the Montreal Street Railway Company from the judgments of the Superior Court, awarding Mr. Jacquemin \$300 for injuries resulting from being struck by a street car while crossing Craig street, in December, 1895, and Miss Chartier damages for injuries resulting from a similar accident on Notre Dame street, were last week dismissed by the Court of Appeal, the decision in each case being based upon the violation by the Street Railway Company's employees of the city by-law ordering that the speed of the cars must never exceed eight miles per hour, and that at all street crossings cars must be slowed up to the pace of a horse walking. The court held that as long as this by-law remained in force it would have to be observed, and the company will have to be held responsible for all damages and accidents resulting from its violation.

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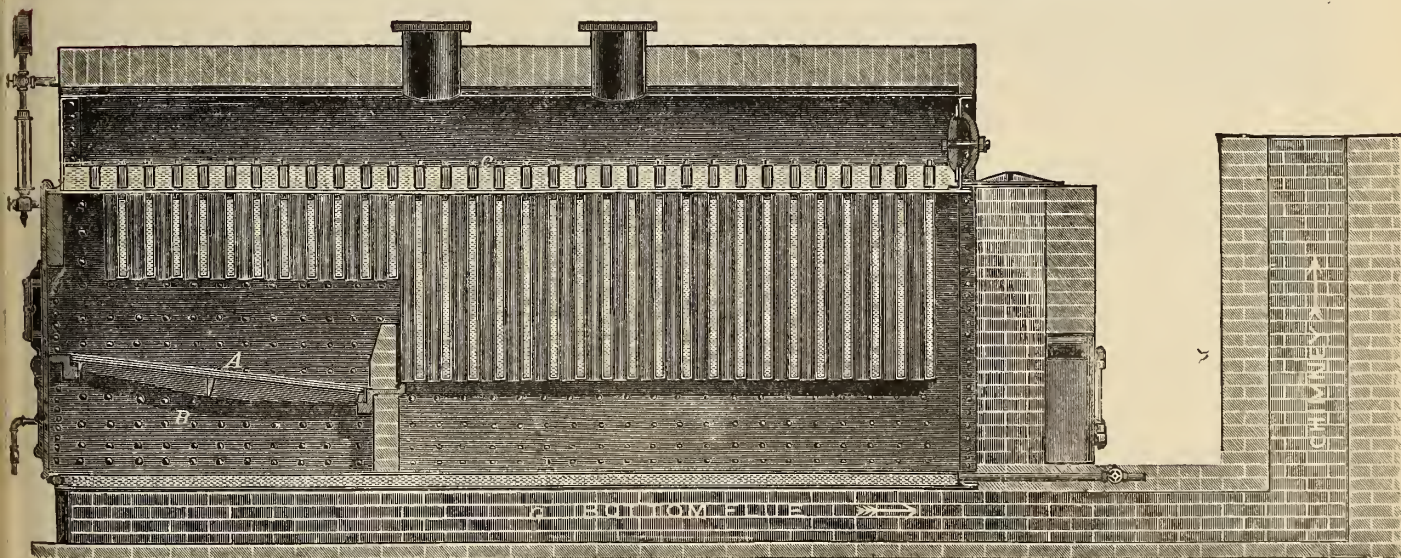
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SPARKS.

The town of Woodstock, N.B., will install an electric fire alarm system.

The Centre Star mine at Trail, B. C., is about to install an electric hoist.

Baird & Son, of Parkhill, Ont., are putting in an incandescent lighting plant.

Larkin & Sangster, of Iroquois, Ont., have put in a small electric light plant.

The city of Chatham, Ont., will call for tenders for an electric fire alarm, to cost \$2,000.

An electric light plant will likely be installed at Maniwaki, Que., for public and private lighting.

Robert Whitelaw, of Woodstock, Ont., has secured the right to manufacture the Shepherd vertical engine in Canada.

The Star mine at Rossland, B. C., is said to be taking estimates on a compressor plant, to be operated by electricity.

Paris, Ont., has made a contract with the Paris Electric Light Co. for street lighting at twenty-three cents per light per night.

The Brussels Electric Light Co., Brussels, Ont., has been succeeded by Robert Mainprize, who continues under the old name.

The Citizens' Electric Light Company closed down its plant at Watford, Ont., last month. There was not sufficient business for two companies.

Ottawa, Ont., has taken the first steps towards the establishment of a technical school, a committee of the Board of Trade having been appointed to devise ways and means.

The city clerk of London, Ont., has received information from several cities in the United States and Canada relative to the cost of operating municipal electric light plants.

At the last city council meeting in St. Thomas, Ont., the advisability of establishing a municipal lighting plant was discussed. The present contract expires in October, 1899.

It is stated that the Electrical Construction Co., of London, Ont., may remove to Kingston in order to secure enlarged premises necessitated by increase of business.

The Golden Cache Mines Co., Limited, of Vancouver, B. C., have invited tenders for water wheel and governor, electrical machinery, compressor plant and drills, 10-stamp battery, etc.

The Montreal Street Railway Co. has just had printed 15,000,000 car tickets, the cost of printing being \$1,100. The company is said to have received \$3,000 for advertising on these tickets.

A committee of the city council of St. John, N.B., has recommended the purchase of a dynamo and additional lamps for the North End electric light station, at an estimated cost of \$1,000.

The International Radial Railway Co. will apply to the Dominion parliament for incorporation, and for permission to extend the time in which to commence the construction of its proposed road.

Mr. C. Bethel, late of H. W. Petrie & Co., Toronto, has connected himself with the Laurie Engine Co., of Montreal. He will have charge of their city warehouse and salesrooms at 321 St. James street.

Mr. McNamara, of Goderich, Ont., has received a letter regarding the Hurontario Electric Railway, which states that there is still hopes of securing the construction of a railway from Walkerton to Flesherton.

The city of Victoria, B.C., recently accepted the following tenders: Dynamo, W. A. Johnson Electric Co., Toronto, \$2,285; carbons, National Carbon Company, \$855; globes and pulleys, Thomas Watson, \$179.

A boiler in Miller's tannery at Orillia, Ont., exploded on April 9th. The explosion blew the southern end out of the building, and scattered large pieces of iron, bricks and stones all round for a couple of hundred yards.

The Toronto Electric Light Company has offered to furnish electric lights for the Island at 25 cents per light per night, terminating at midnight. A proposition made by Ald. Hanlan to operate a private plant is under consideration.

Arrangements have been completed for the installation of two electric plants, one at Napanee and the other at Newburgh, for the purpose of lighting the villages of Yarker, Newburgh, Camden East, Napanee Mills and Napanee.

The Sarnia Gas & Electric Light Co. recently closed a contract for a complete set of modern gas appurtenances with the Western Gas Construction Co., of Fort Wayne, Ind. The company have appointed Messrs. Baxter & Lynn, of Detroit, consulting engineers.

Saxby & Dryden, of Kingsville, Ont., are building their power house, in which will be installed a 500-light alternator, 50-light arc machine, 60 h.p. steel boiler and 50 h.p. engine, with pump and heater. The engines and boilers have been purchased from E. Leonard & Sons, of London, Ont.

The city of Kingston recently entered an action against the Kingston, Portsmouth & Catarauqui Electric Railway Co., to compel the latter to keep their cars running over the whole of their system during the entire year, pursuant to agreement. A decision in the case has not yet been given.

Messrs. P. A. P. Lariviere, J. M. Nunns, Dame Genevieve Thivierge, and Eulalie Lariviere, of Melbourne, Que., and H. F. W. Bellow, of Montreal, have asked for a charter as La Compagnie d'Aqueduc de Richmond. The powers asked are extensive, including electric light, motive power, etc. The capital stock is \$100,000.

The Tree Rotary Engine Company, of Woodstock, Ont., held their first meeting of shareholders on Thursday, April 7th. The following officers were elected: Louis Kaufmann, president; A. J. Wilson, vice-president; J. A. McKay, secretary-treasurer. Messrs. Kaufmann and McKay are managing directors.

The Canadian General Electric Co. have a contract for supplying three direct connected units for the C.P.R. steamers which are to go on the Stickeen route. These units will consist of a 4 kilowatt 70 light incandescent dynamo, direct connected to a vertical high speed engine, running at 600 revolutions per minute.

The proprietor of the Stayner Electric Light Works has made a proposition to light the streets of Acton, Ont., offering to place 40 electric lights and maintain them for \$450 a year. It is estimated that the necessary plant and building would cost \$6,000. Before deciding, the councillors will investigate the outlook for a municipal plant.

The officers of the International Exhibition, to be held in Turin, Italy, have offered a prize of 15,000 lyre (about \$3,000) for the best invention or machine devised for the application of electricity to industrial purposes. The competition is open to all nations, and a committee of international authorities will be appointed to award the prize.

It is not often that we hear of farm houses having telephonic communication. At Goulbourne, Carleton County, there are three sons and two daughters in the Healy family, all living on different farms, and they have their houses connected by telephone. Each has a number, and although when a phone is rung all can hear the ringing, there is no confusion, for each one knows his or her number of rings, whether one, two, three, four or five.

The Canadian General Electric Co. are installing a direct connected lighting unit on board the C.P.R. steamship Athabasca, consisting of a 500 light incandescent dynamo, direct connected to a 50 h.p. high speed "Ideal" engine. This unit, which is very compact, occupies a floor space of 6 x 9 ft. The dynamo is of the latest steel frame multipolar type, with ventilated armature. A marble switchboard, on which are mounted a standard equipment of instruments, is also part of the new equipment, which, when finished, will be the most complete on any of the steamers now running on the upper lakes.

The New York Court of Appeals has given a decision which, according to report, makes the electric street railway trolley patents public property. Under patents granted to Vandepoel, the General Electric Co. has for years held the exclusive right of manufacturing trolleys. Some time ago the Walker Company began the manufacture and sale of an electric trolley on an extensive scale, resulting in a series of suits against that company by the General Electric Co. In his last statement of the assets of the General Electric Company, President Coffin included an item of \$1,000,000 as the value of the Vandepoel trolley patents.

Mayor Shaw and other representatives of the Toronto City Council visited Niagara Falls recently for the purpose of inspecting the electric power works which have been established on the American side by the Niagara Power Company. Questioned regarding the possibilities of transmitting power to Toronto, Mr. W. B. Rankine, manager of the company, stated that the loss in transmission to Buffalo was 12½ per cent., and a further loss of 6 per cent. was incurred in distribution in the city. What the loss would be in the longer distance to Toronto he did not know, but Mr. Stillwell, the electrician of the company, estimated that it would be at least 25 per cent.

The British Columbia Electric Railways Company, of Victoria, B.C., are having installed a complete plant for developing the water power at Goldstream, for operating the street railway and the electric light plant. The work is being done under contract by Hasson & Hunt, mechanical engineers, of San Francisco, Cal., and the plant is expected to be in operation by midsummer. The power house will be stationed at Goldstream, about twelve miles from Victoria. The contracts for the electrical and hydraulic machinery have been closed, and the construction is being pushed with rapidity. The electrical apparatus will be of the Canadian General Electric three phase type, using rotary convertors and transformers to distribute over the line as the two phase with a voltage capacity of 11,000. Two Pelton water wheels will be used, with a capacity of 600 horse power each, delivering 1,000 horse power in Victoria. Provision is also being made for 600 additional horse power if required. The power delivered in Victoria will be sufficient to operate the street railway, electric lighting system, commercial and municipal, and also to furnish considerable power for the operation of stationary motors for manufacturing purposes, elevators, etc.

JAMES MILNE

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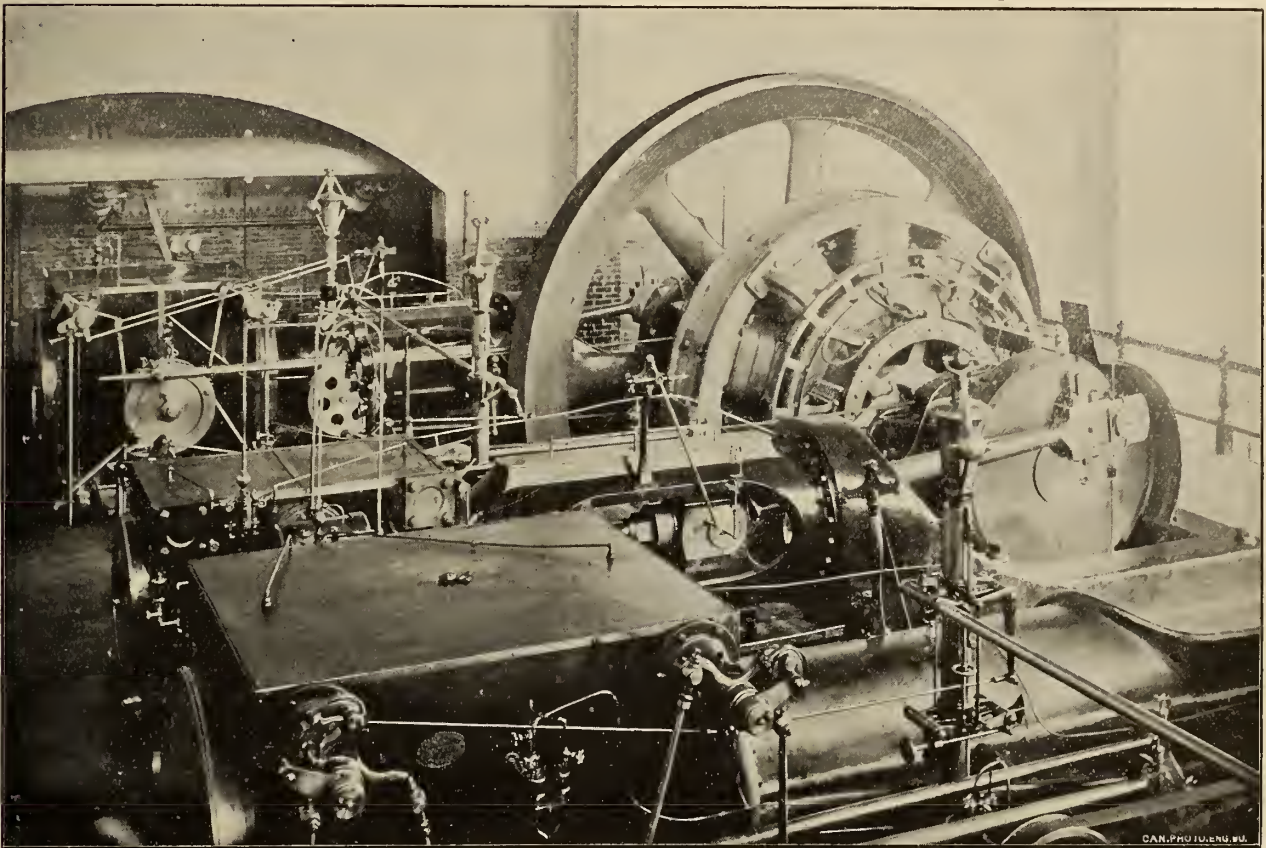
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SPARKS.

There is a movement on foot at Bradford, Ont., in favor of securing electric light.

The Windsor Hotel, Montreal, are installing two 1000 light Canadian General Electric Company incandescent dynamos.

La Compagnie D'Electricity De Soulanges, of Coteau Landing, Que., has applied for incorporation.

The Doherty Organ Co., at Clinton, Ont., have purchased a 500 light incandescent plant from the Canadian General Electric Company.

The Board of Works of the London, Ont., city council recently struck out the recommendation to purchase a boiler for the city hall.

The town of Granby, Que., will submit a by-law to the rate-payers to raise \$50,000, a portion of which is intended for the purchase of an electric light plant.

The Ontario Rolling Mills Company, Hamilton, Ont., have purchased an incandescent lighting plant from the Canadian General Electric Company.

The Linde British Refrigerating Co., of Montreal, have placed an order for 115 h.p. capacity in induction motors with the Canadian General Electric Company.

It is stated that the directors of the Cataract Power Company, of Hamilton, Ont., have already under consideration the enlargement of their canal from DeCew's Falls.

The Canadian Pacific Navigation Co. have purchased from the Canadian General Electric Co. a 125 light incandescent plant for one of their steamers, running from Vancouver to the Stickeen river.

The Brandon Electric Light Co., of Brandon, Man., has placed

an order with the Canadian General Electric Co. for two 65 kilowatt incandescent dynamos, of their latest and most approved direct current type.

The Canadian Development Co., of Victoria, of which Mr. H. Maitland Kersey is managing director, have ordered three incandescent light equipments for their new steamers from the Canadian General Electric Co.

The London Electric Company are increasing their plant, and have ordered from the Canadian General Electric Company a 6,000-light single-phase alternator and two 160-kilowatt direct connected direct current generators.

The Toronto Electric Light Company have just completed the installation of four 4,000-light, single phase, revolving armature alternators, for which an order was placed with the Canadian General Electric Company some time ago.

The town of Barrie, Ont., has invited tenders, to be received by June 6th, for a complete electrical plant, consisting of 2,000 c.p. arc plant, 65 lamps, 2,000 lamp incandescent plant, power service plant and a 325 h.p. steam plant, with all necessary fixtures.

Mr. J. T. Taylor, representative of the Canadian Underwriters' Association, is at present making a personal inspection of the wiring in the central stations, isolated plants, public buildings and large business places in Ottawa, and will shortly visit Toronto for the same object.

The Montreal Cotton Company are increasing their power plant, which at present consists of two 400 kilowatt three-phase Canadian General Electric alternators, and 1000 h.p. capacity in induction motors, by the addition of two more 600 h.p. generators of the same type and 1200 h.p. in induction motors.

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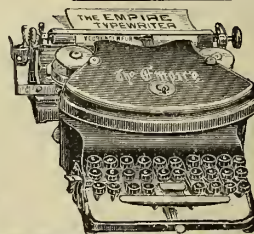
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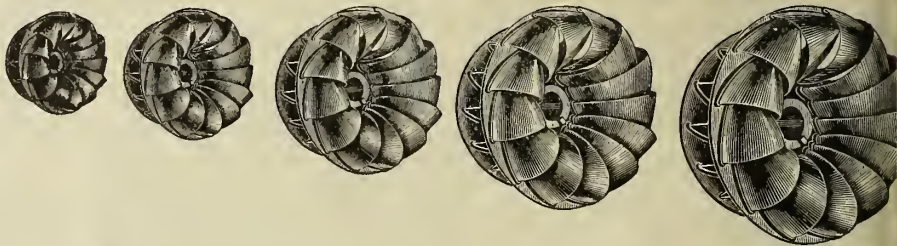
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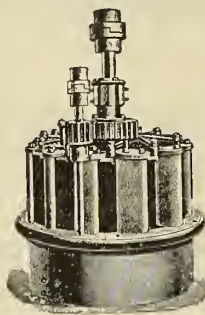
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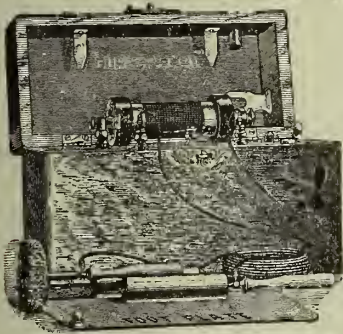


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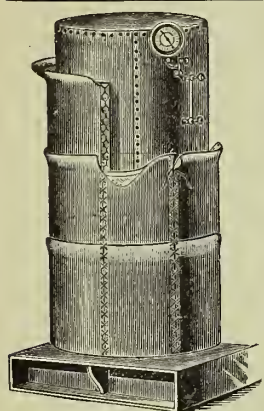
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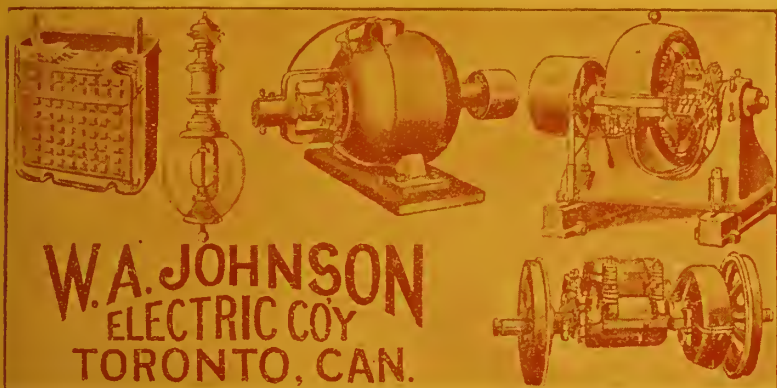
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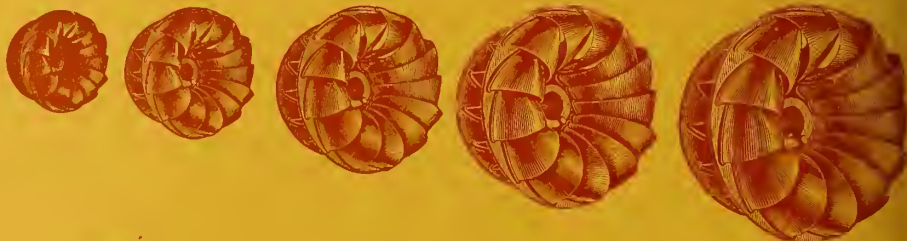
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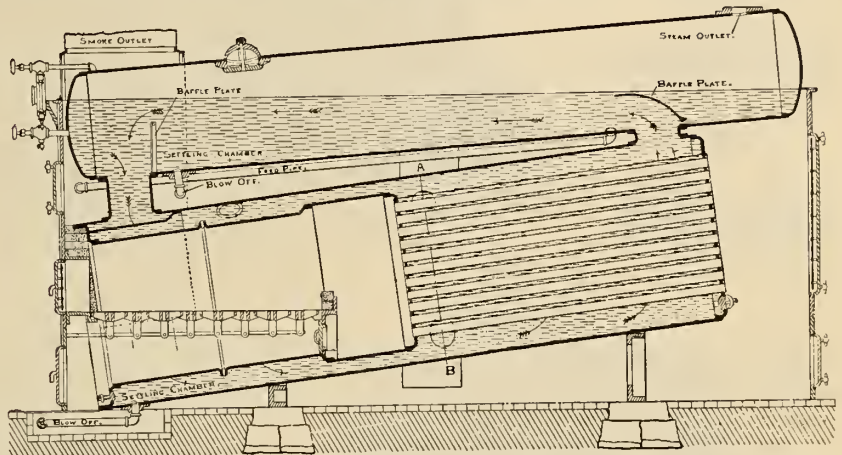
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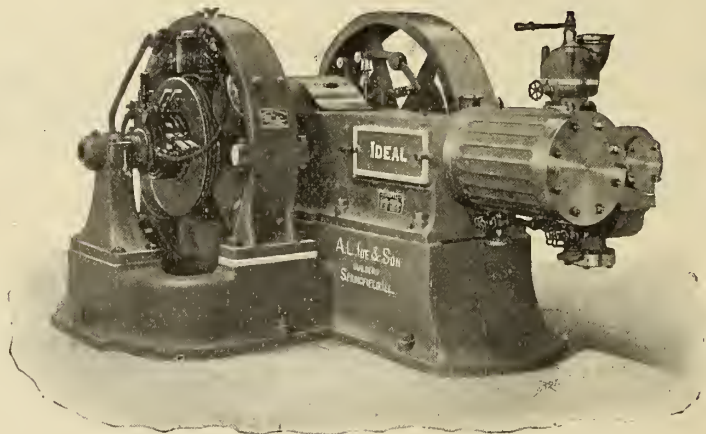
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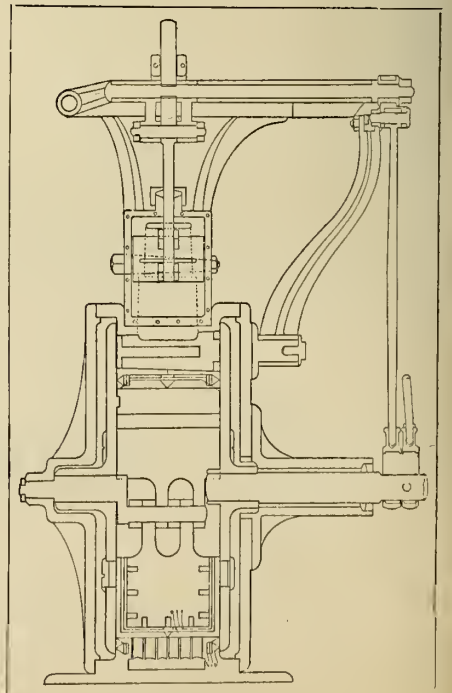
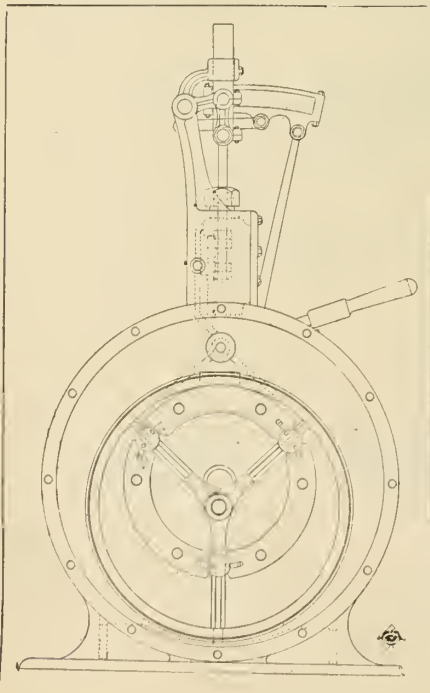
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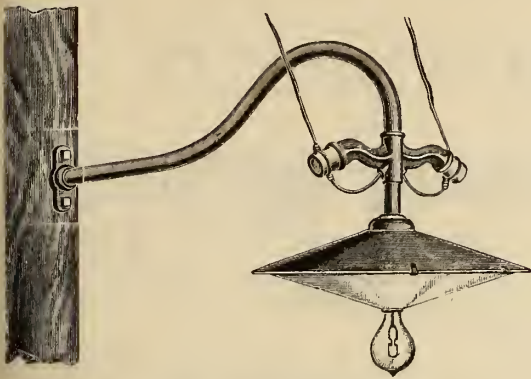
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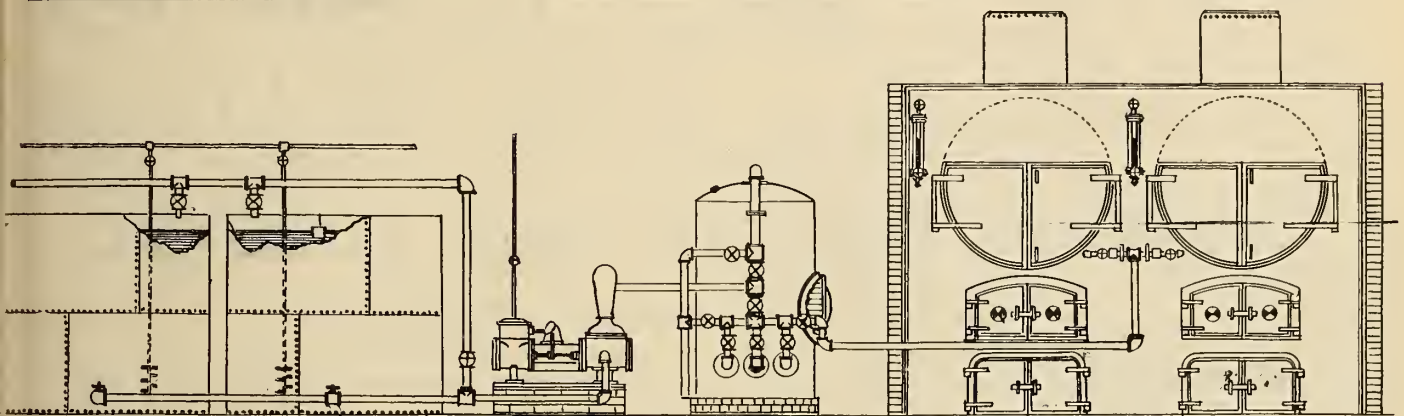
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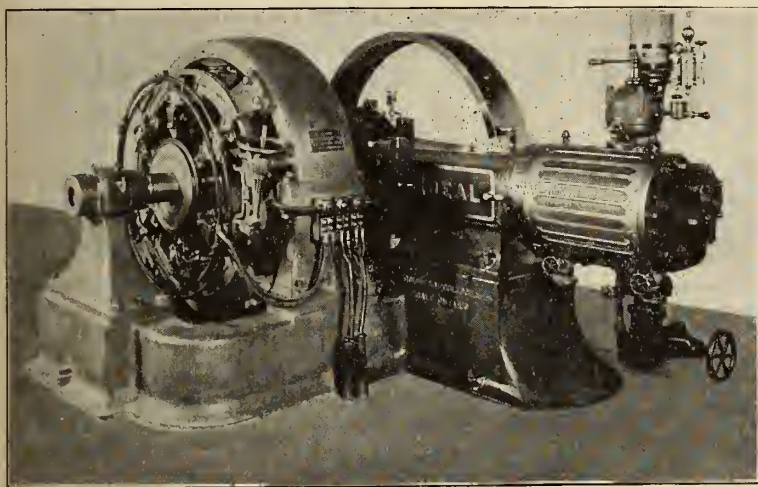


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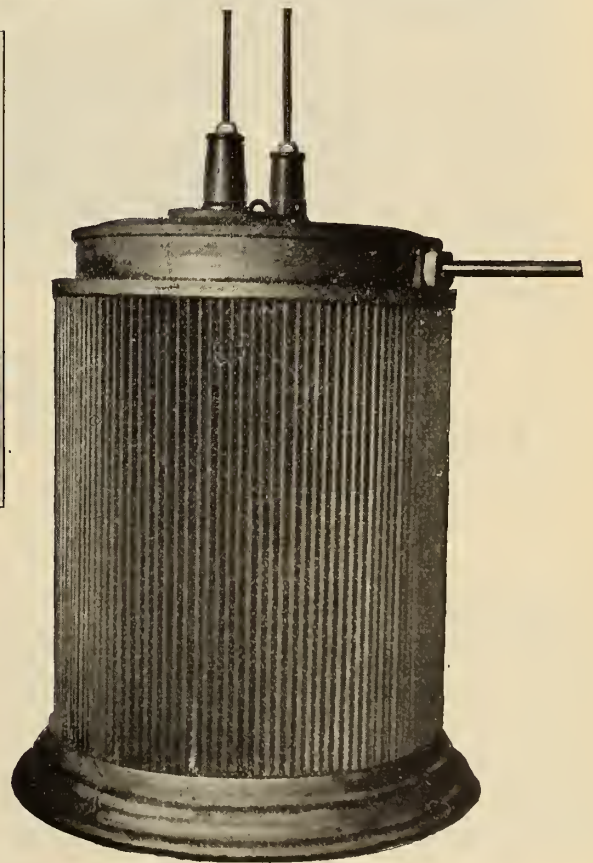
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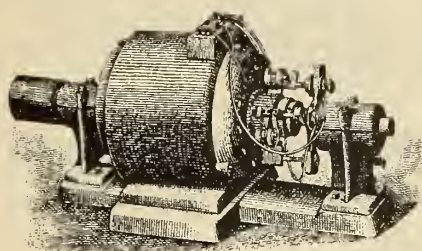
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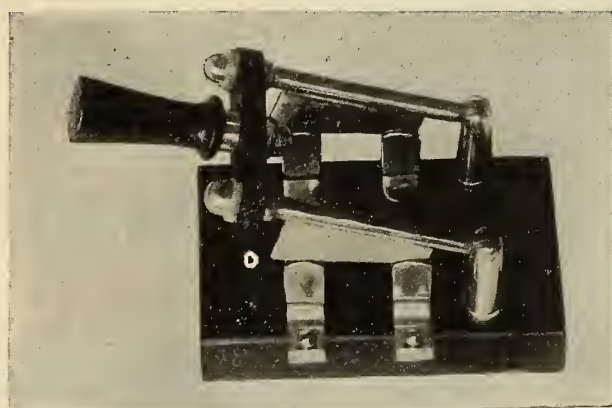
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INSPECTION OF THE CATARACT POWER COMPANY'S WORKS.

MUCH interest has been taken in the scheme of the Cataract Power Company to transmit electric energy from St. Catharines to Hamilton, owing to the fact that it is the first attempt in Canada to transmit current a distance of 35 miles. Such an undertaking naturally embodies many interesting engineering features, and difficulties must be overcome which had not heretofore been met with. The promoters of the above company are Hon. J. M. Gibson, James Dixon, John Moodie, J. W. Sutherland, John Patterson and E. B. Patterson, all of Hamilton, the latter being the originator of the project. It is to these gentlemen that credit is due for the enterprise and courage shown in financing the undertaking.

With the object of witnessing the progress that had been made a representative of the ELECTRICAL NEWS

structured about forty years ago for the purposes of navigation, connecting Lake Ontario with Lake Erie, and being about twenty-seven miles in length. In less than twenty years afterwards it was found to be too narrow for the large vessels then sailing the lakes, and a new

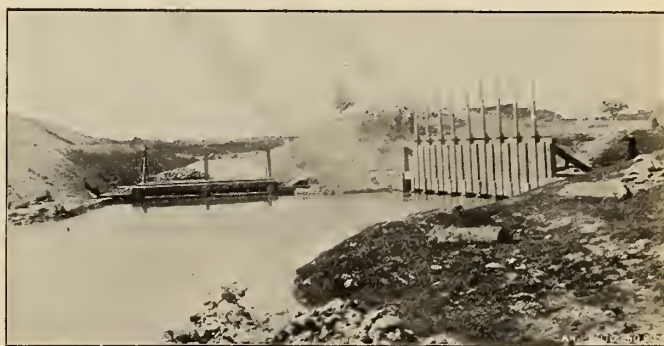


FIG. 1.—CATARACT POWER COMPANY—HEAD GATES.

canal was built for the greater portion of the distance, joining the old canal near the village of Allanburg. It is almost at this junction that the canal is tapped to permit of the water being utilized for the generation of electricity, which in turn provides the motive power for industries in a city nearly forty miles distant. It will be seen that a constant supply of water is assured.

At the intake we find constructed the necessary head gates, of which there are two. These are shown in Fig. 1. From the head gates the water is conducted through an artificial channel or canal, as before stated, the first section of this work being also shown in Fig. 1. Work on this canal was commenced in November last, but had to be suspended during the winter months, as it was found impossible to make the banks water-tight owing to the frost. Proceeding along the canal, we find some 200 men, with teams, engaged in construc-



DIAGRAM SHOWING SOURCE OF SUPPLY AND PROPOSED CANAL—CATARACT POWER COMPANY'S WORKS.

recently visited the works, now in course of construction, and found that within one month the entire project will probably be completed.

To give an understanding of the scheme, it should be said that the company propose to obtain the water supply from the old Welland canal at Allanburg, and carry it by means of an artificial channel four and one-half miles in length to the brow of the mountain overlooking Twelve-Mile Creek, just east of DeCew Falls, and about two miles from St. Catharines. From the escarpment of the hill the water will be led down the face of the cliff by a huge steel pipe, the fall being 275 feet. At the foot of the hill will be located the power house, where the current will be generated and transmitted to the transformer station at Hamilton for distribution for lighting and power purposes.

Returning to the source of supply, it is scarcely necessary to explain that the Welland canal was con-

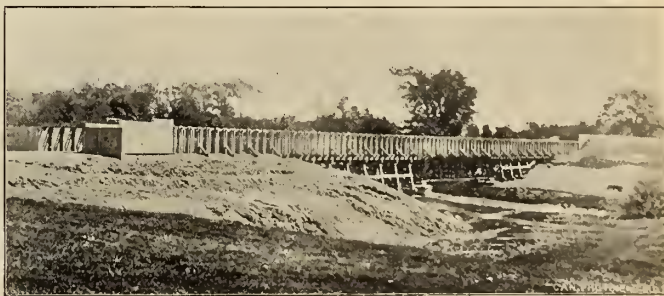


FIG. 2.—AQUEDUCT OVER BEAVER DAM CREEK.

tion, filling in and excavating. Incidentally, it might be mentioned that the work has proved a boon to the farmers in the vicinity, who, besides selling at a good price the land necessary for right of way, are reaping additional benefit in the way of employment. The building of the canal necessitated the removal of immense quantities of earth, the required excavating

being about equal to the filling in. The heaviest cut was about 18 feet. For a distance of two miles from the intake the canal is now practically completed. Coming to the Beaver Dam creek at Miller's farm, about two miles from Allanburg, we observe a large aqueduct nearing completion for the purpose of carrying the water across the creek (see Fig 2). This is a wooden

then 8 ft. 6 in., 8 ft., and 7 ft. 6 in. to end. It was rolled and put together by the Hamilton Bridge Company, and is a creditable piece of work.

The power house is located on the south bank of the Twelve-Mile creek, into which the water will discharge direct, the points of discharge being shown in Fig. 3. Workmen are still engaged on construction, although the exterior presents a completed appearance. It is 175×40 feet, the walls 30 feet in height, the framework being of steel filled in with brick. The roof is covered with lap seam metal. The floor is of concrete three inches thick, but where the generators and turbines will be located it will be laid to a depth of 12 feet. It is intended to finish the interior of the power house in white. No machinery has as yet been installed except a large travelling crane capable of carrying up to 20 tons. The generators, of which there will be four, will be located on the north side, as well as two exciters. The dynamos will, it is said, weigh 67 tons each. All the electrical apparatus, including dynamos, transformers, etc., is now nearing completion at the works of the Royal Electric Company, Montreal.

The water wheels have been manufactured by the the Stilwell-Bierce and Smith-Vaile Company, of Dayton, Ohio, and will be placed in position at once. They are necessarily of special design, with steel fly wheels weighing $7\frac{1}{2}$ tons each, the total weight of case and turbine being 30 tons. The current will be generated at the power house at 22,500 volts, and transmitted to the transformer station at Hamilton, where it

flume, 600 feet in length, 450 feet in the clear, inside diameter 8×8 feet, and supported by a steel truss. The top of the flume is two feet below the level of the canal, thus ensuring a constant pressure.

From this flume to the brow of the mountain there is considerable work yet to be completed, and numerous small bridges are in course of construction. It is the intention to have three large storage basins, one of which is completed. These will contain sufficient water for two days' operation, and will remove the danger from frazil, or small particles of ice getting into the water wheels. There will also be built, at the brow of the mountain, a concrete wall 600 feet in length and 15 feet high.

At this point we reach the most interesting portion of the work. After cutting away the bush for several hundred feet in width, a cutting 38 feet deep and 14 feet wide was made in the rock at the top of the bank, in which will be placed the pipe line. This is shown in Fig. 3, but the correct impression can only be gained by remembering that the distance from the top of the mountain to the base of the power house is 900 feet, and the fall in that distance about 275 feet. This gives a head nearly double that of Niagara Falls, and a pressure of 135 pounds to the square inch.

The construction of the pipe line is very interesting. The heel is about two-thirds of the way down, and is shown in Fig. 4. Only a portion of the pipe is yet in position, but it is all on the ground ready to be placed. The foundation for the pipe line is made of stone, with a pier and drain every 12 feet. At the commencement the pipe is three-eighths of an inch in thickness, gradually increasing to one inch. It is a circular steel tube, 900 feet in length, the first section being 9 feet in diameter,

will be reduced by step-down transformers to 2,500 volts.

The pole line has been completed for a distance of about 25 miles. Cedar poles 35 feet long are being used, with heavy cross arm, and Locust wood pins, boiled in linseed oil to increase their lasting and insulating qualities. There is a neat angle iron brace on the poles, making a remarkably solid job. The insulators,

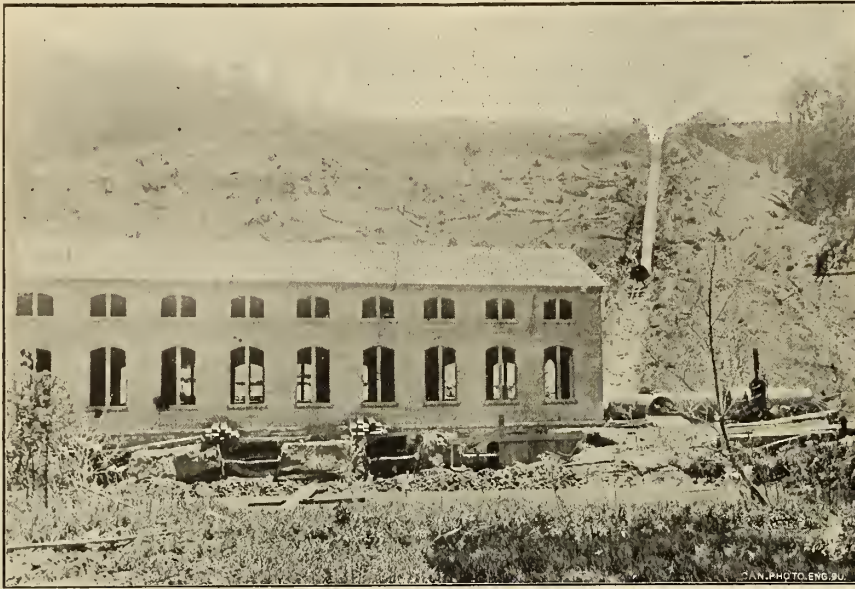


FIG. 3.—CATARACT POWER COMPANY—POWER HOUSE AND PIPE LINE.



FIG. 4.—CATARACT POWER COMPANY—PIPE LINE, SHOWING HEEL.

which are porcelain, are tested at an enormous pressure before being placed on the line. The line consists of 4 separate strands of No. 4 B. & G. gauge copper wire. The poles are placed 90 feet apart, thus necessitating the use of about 2,000.

The transformer station at Hamilton is also nearing completion. It is 50 x 100 feet, and of similar construction to the power house.

The completed work will cost in the neighborhood of \$600,000. Messrs. Angus McDonald & Co., of Thorold, Ont., are the contractors for the canal, head gates, etc.; the Royal Electric Co., of Montreal, will supply the electric machinery; Messrs. Lowe & Farrell, of Hamilton, the pole line, with Mr. Woodman in charge of construction. Mr. H. R. Leyden, late of the Royal Electric Co., is general manager of the company; Mr. Wm. Kennedy, of Montreal, hydraulic engineer; Mr. T. E. Hillman, engineer in charge; and Mr. C. W. Moody, superintendent of construction of pipe line and power house.

The company expect to transmit power regularly to Hamilton before the close of July. In a later issue we expect to give a more detailed description of this interesting engineering work.

MR. F. C. ARMSTRONG.

Mr. F. C. Armstrong, general agent of the Canadian General Electric Co., has resigned from the staff of that company, having accepted an appointment to fill a similar position in connection with the electrical department of Dick, Kerr & Co., Limited, the well-known engineering and contracting firm of London, England.

Mr. Armstrong, who is well known in his official capacity to the electrical fraternity throughout the Dominion, is a Canadian by birth, and was educated under Dr. Tassie at Peterboro', Ont., and at Toronto University.



MR. F. C. ARMSTRONG.

He engaged in electrical work after leaving the University in 1889, and spent three years in those pioneer days of the industry in construction and engineering work.

Since 1892 he has been identified with the Canadian General Electric Co., and in the important position

which he has filled has obtained a wide experience in electrical engineering and business matters, which should be of the greatest service to him in his new and more extended field.

Mr. Armstrong's departure will be felt as a loss by the members of the Canadian Electrical Association, to the success of which he has largely contributed by the preparation of serviceable papers, and as a member of the Executive Committee.

TO READERS.

This number of the **ELECTRICAL NEWS** contains the announcements of a large number of the leading manufacturers of electrical and steam engineering apparatus and supplies. Our readers are asked to peruse carefully the advertising pages, and when in need of goods of the character mentioned, to communicate with advertisers, mentioning their advertisements in this journal. This will be appreciated both by advertisers and the publisher.

THE MOOTED WIRELESS TELEGRAPHS.

By D. H. KEELEY, M.I.E.E., A.M. Can. Soc. C.E.

A STUDY of the published accounts of investigations made in the field of wireless telegraphy perhaps reasonably leads one to the conclusion that the different systems are after all identical in principle and dependent for their operation upon the effects purely and solely of electro-magnetic induction. Once this conclusion is arrived at, one might well pause to question the reasonableness of great expectations from such means of communicating actual influences between points more or less widely separated.

It will perhaps serve a useful purpose to go over the ground from the writer's point of view, because, if it be not altogether incorrect, it may occasion some fresh arguments, and thus help to put the subject on a yet broader basis for treatment.

CURRENT INDUCTION, PURE AND SIMPLE.

To start from the beginning: Faraday's researches produced the induction coil, that in its more efficient form takes the shape of our modern transformer. The primary and secondary coils are wound on a common core, or, in the absence of a core, are in such juxtaposition that the lines of force begotten by one coil pass through and embrace the other. The effect of a pulsation of E.M.F. through either is the momentary creation of a magnetic field, which in its rise and subsidence produces in the other coil precisely the same effect as would the momentary insertion into and withdrawal from it of a permanent magnet of the same power. That being so, it follows that if the coils are axially separated a given distance—thus permitting some of the lines of force created by the primary to complete their circuit short of the secondary—there is producible in the latter the effect of the introduction and withdrawal of a magnet of such reduced strength as is represented by the rest of the lines of force that are projected through and embrace it.

It seems this transmitted influence is subject to the same law as that governing the transmission of light, the intensity being inversely as the square of the distance from the source, so that, if at a given distance a certain effect is produced, it calls for four times the power at the source to produce the same effect at twice the distance, and sixteen times the power at the source to produce the same effect at four times the distance, and so on. It is then readily conceivable that to produce a measurable effect at a very considerable distance, the energy required to be applied to the primary must be enormous. Then, too, the greater distance we put between the coils the more nearly equi-distant they become, comparatively, between all their parts; and in the absence of an actual core conducting the lines of force, some of these latter will pass outside the distant coil and neutralize a corresponding number passing within.

Obviously the simplest way to meet this condition is to enlarge the diameter of the coils, so as to preserve a distinctive difference between the distances at which the respective sides of the two coils stand in relation to each other. Equally obvious, however, this expedient has but narrow limitations.

An experiment in this direction, perhaps on the largest scale ever attempted, is given an account of by Mr. C. A. Stevenson in *The Electrician*, London, August 3, 1894, Vol. XXXIII, P. 388. It was proposed to establish communication between North Unst light-house, off the coast of Scotland, and the mainland—a distance across the water of one-half mile—and apparatus was got up to demonstrate what was required. Two huge coils "of nine turns of No. 8 iron wire in each coil, the coils being 200 yards in diameter," and presenting a resistance of 24 ohms, were laid down somewhere between Glasgow and Edinburgh at a distance apart of 850 yards. The applied current varied from one-half to one ampere, and signals (received in a telephone) were transmitted satisfactorily, the effect being of course better as the strength of the current was increased.

In experiments such as these, the practice has been to apply a rapidly alternating current to the primary coil, which produces in the distant secondary coil currents of sufficient strength to cause in a telephone included in its circuit a humming sound that can, by means of a key at the sending end, be set up and stopped at will, thus affording the elements of the Morse code, whereby the telegraphing is accomplished.

The unwieldiness of such apparatus as this, as well as the limitations of its application, made it manifest that something further must be accomplished before wireless telegraphy could be regarded as on the way to practical achievement.

HERTZ WAVES.

Was there anything left unconsidered in working the idea up to the stage arrived at in the foregoing?

We can best look into this question by returning to a considera-

tion of first principles. Let us first consider one of the coils—simply a wire wound in many convolutions. In early text-books it was called a MULTIPLIER—a multiplier of the effect that was referable to the employment of a single convolution. Let us take then a single convolution. If through this single turn of wire we pass a current of 10 amperes, we have 10 ampere turns; and since M.M.F. is proportional to ampere turns, we will by this single convolution be enabled to produce an electro-magnetic effect equal to that of a coil of 20 turns, to which we apply a current of half an ampere? Grant this. Then the single convolution is an important basis to start out from. In fact, one at once rises to the conception of a current so powerful that in passing through a single convolution would produce a magnetic field so intense as to project lines of force for unlimited distances.

But why stop at a convolution? If a single complete turn can do so much, it stands to reason a part of a turn—or say one side of the square, if the core space is quadrangular—will be proportionately effective.

Seeing then that a magnetic field is obtainable by the passing of a current along a straight wire, might we not go further, dispense with the wire altogether, and by causing the current to pass along an imaginary path, as across an air-gap, obtain likewise on all sides of this path that self-same magnetic field? It seems rational to suppose so. And if this whole line of reasoning is rational, might it not be admissible to assume that this was the road that led to the evolution of the Hertz Oscillator (see note 1) which to all interests and purposes fulfills this function of passing the current along an imaginary path (between the knobs of the spark gap of the machine) and projecting the magnetic lines of force in the way suggested. If this is correct, then one might readily believe that the alleged Hertz waves, about which so much has been heard lately in connection with the wireless telegraph experiments, are not Hertz waves at all. These latter are declared to be something distinctively peculiar and directly emanating solely from the spark gap of the apparatus. They may be a characteristic of the spark itself, belonging to another sphere of research. The great difference is that the effects we are dealing with here are apparently not confined to the spark gap, but are simply incidental to the passage of the current across the gap and common to all parts of the circuit.

If these effects have been mistaken for those attributable to Hertz waves proper, the chances are that, the distinction being suggested, the methods of attempting to utilize them will undergo some modification.

MARCONI'S ADAPTATION.

The most frequently mentioned personality in connection with the wireless telegraph of late is the clever student Marconi, who, with the co-operation of Mr. Preece, is exploiting and experimenting on an elaborate scale in England with an apparatus of his own that he is understood to describe as a refinement of what has heretofore been employed by others in the field. Hertz waves—influences directly projected from the spark gap—are the suppositions (or actual?) basis of his transmission. The receiver, a unique and original combination of ordinary Morse instruments, with a device that turns to account some peculiarities of metallic particles, and descriptively called a "coherer" (name due to Dr. Lodge, though he says he gave it to a different contrivance; see note 2), that is responsive to the feeblest magnetic influence. For description of this apparatus see references given in note 3. It is with his receiver maybe that Marconi's name will pass down to our distant posterity. He has been able, it appears, to telegraph over distances ranging from 9 to 20 miles with this machinery. Most all accounts, however, mark the performance as rather unreliable, still there is no gainsaying the wonderfulness of the achievement. The oddest thing of it all is, that despite the view that is understood to obtain with him as regards the nature of Hertz waves, the latest accounts represent that the greater distances are spanned and stronger effects produced by the employment of kites or balloons carrying terminal plates leading to the respective instruments.

Now, if the transmitted influences are projected direct from the spark gap, what on earth can the elevated terminal extension effect? The recourse thus had seems to support the view hereinbefore advanced. For if, during the passage of the spark across the gap, a given M.M.F. is produced, it must be that all parts of the circuit contribute to this production. The terminal plate, at the transmitting station, and its connecting wire take a part of the

charge as well as any other part of the contrivance. Then the wire being for most part high above ground and nearly perpendicular to it, affords very little inductive capacity, and there is possibly no retardation at all in it; so that while the spark is passing between the knobs of the machine the terminal plate discharges, and this connecting wire for the instant has a flow of current down its length just as if it were part of an actual circuit, and its electro magnetic effects are probably more widespread than those due to the operation of other parts of the outfit.

If this is the explanation of the improved results it opens up a wide prospect for the simplification and permanency of the signalling plant.

POSSIBILITIES AHEAD.

Something remarkable has already been accomplished by those who have labored to bring about the results we have now in hand. But having grown accustomed to the marvellousness of it all, one can read with patience the arguments lately advanced as to the utter impracticability of adopting the system at its present stage for any actual service. The expedient of employing kites and balloons to help the matter out is regarded as the worst feature of the whole. It seems to be overlooked that in practice these would be replaced by some high towers and a hill or two at moderate range. However, if what is advanced in the foregoing has any scientific foundation, the necessity for extraordinarily high acrid exposures does not really exist.

An important circumstance seems to warrant this latter conclusion, as one can readily conceive, in view of it, that it is the wire itself more than its kite suspension that is efficacious. Let it be stated that, in offering the suggestion contained in the foregoing as to the part played by the kite-supported terminal plate and wire, it is reasoned that the volume of current passing down that single wire at the instant of discharge cannot easily be compared with the current that coursed through the big coil in the experiment described in the earlier part of this paper. Whence, then, its assumed widespread effects? Might they not be due to the suddenness with which the impulse moves? We have, on the one hand, a coil self-inductive and sluggish, as compared on the other hand with a single wire free from retardation. The lightning speed of the discharge may do more execution along that single wire than many times the same volume of current in the hampered convolutions of the coil.

If this reasoning is sound, the line upon which further advancement is to be made is clearly indicated.

Indeed, the influence exerted by a single wire circuit at a distance, even if in rather a bad way as regards retardation, has been well demonstrated in actual practice. The instance is found recorded in *The Electrician*, London (12th April, 1895; vol. XXXIV., p. 723): "The cable connecting Oban with Auchnacraig having broken down, a gutta percha insulated wire 1½ miles long was run along the ground from Morven, whilst on the Isle of Mull the ordinary overhead circuit connecting Craignure with Aros was made use of; the distance intervening between the two parallel circuits was about 3½ miles. Using a vibrator as a transmitter, and a telephone as a receiver, the usual telegraphic traffic was dealt with until the cable was repaired."

Now, considering this performance in the light of the argument already offered, we would expect that if the insulated wire, instead of forming a closed circuit with alternating currents (as is implied by the "vibrator"), had been provided with a spark gap and associated with the discharge apparatus, it would have been found immensely effective. It is the seeming warrant we have for such expectations that should give the single wire first place in the equipment of the signalling station of the future.

There are two or three important points to be borne in mind in considering the possibilities of the wireless telegraph from the standpoint of practice. The system, unless capable of a multiplication of "lines" of communication, will be useless for any extensive application. To be reliable the apparatus must not be over-sensitive; if it can be made adjustable, and if near proximity will admit of wide range of adjustment, rendering the receiver insensitive to interferences, a rough adjustment to this end should be chosen, even at the cost of numerous relay plants or stations. Then, too, these latter will have to be automatic.

This is a heavy bill of requirements, and a lot of engineering will have to be performed ere it can all be realized.

The British American Corporation of Rossland are pushing the development of their properties to the fullest possible extent. The Jenckes Machine Co. of Sherbrooke, through their Rossland branch, have supplied them with special pumping apparatus for their Nickel Plate and Columbia and Kootenay mines.

NOTES. 1. *The Electrician*, London, Vol. XXXIII., p. 153, contains descriptions by Dr. Lodge.
2. *The Electrical Review*, London, Vol. XLII., Art. Physical Society, p. 160.
3. *The Electrical World*, New York, Vol. XXXI, p. 17.

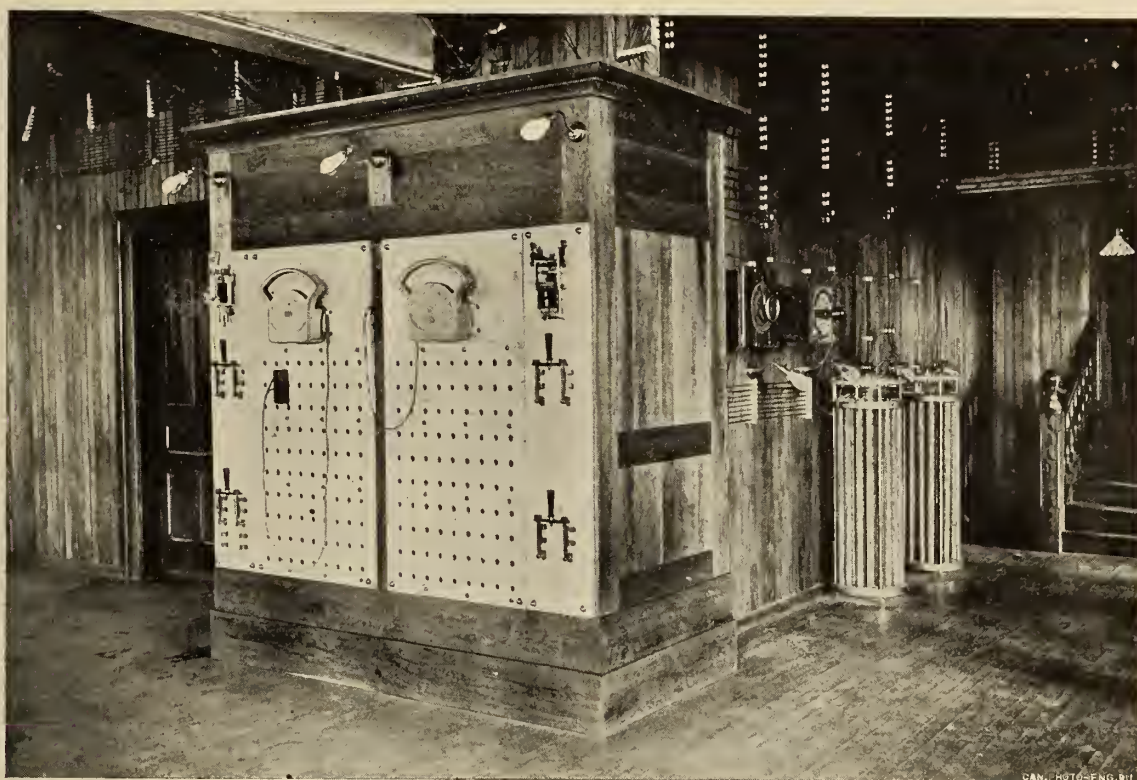
SWITCHBOARD AT SCHOOL OF PRACTICAL SCIENCE, TORONTO.

By T. R. ROSEBRUGH.

A SWITCHBOARD for experimental purposes or for class work must, above all things, permit the greatest latitude in making connections, or, in other words, provide a high degree of "flexibility." In this respect it differs markedly from the switchboard of a power station, whose highest requirement is convenience in performing a certain definite service. This will perhaps be made clearer by example. A street railway generator is required solely for the purpose of supplying current to certain busbars, then it is either idle or appropriately connected by a switch directly to its work, and any more round-about connection would be both unnecessary and very inconvenient. On the other hand, a dynamo in a laboratory has no one duty; to-day its magnetization curve or one of its characteristic curves may be required, to-morrow it may be run as a motor to obtain

lighting. Another peculiarity of a laboratory switchboard is that the total number of connections to be provided for is likely to be many times as great as the number in use at any one time, so that to furnish every dynamo with suitable switches, rheostats and a magnetic cut-out, would result in an extremely unwieldy and expensive switchboard.

With this introduction, the arrangement of the switchboard recently constructed at the School of Practical Science may now be described. The two inner panels seen in the illustration are of marble, 2 inches thick, and 60 in. by 30 in. The arrangement of each of these panels may be understood by supposing thirty socket-sets, each of which is represented by Fig. 1, arranged in three columns of ten each; there are thus in all the six columns, *A, B, C, D, E, F*, numbered vertically downwards from 1 to 10. In the upright between the panels are also, similarly marked and numbered, six strips of ten jacks each, the same as are used in metallic



SWITCHBOARD AT SCHOOL OF PRACTICAL SCIENCE, TORONTO.

its mechanical characteristic; another day its friction and iron losses may be measured. Or, to put it from the point of view of switchboard requirements, it is necessary, within reasonable limits, to be able to separately supply the fields with any current, the armature (as dynamo) with any resistance in circuit, or (as motor) with any potential difference. Evidently, under so varied conditions, all that can be done without limiting in some way the possible uses of the machine, is to provide at the switchboard two pairs of terminals, one for the armature and one for the fields. This need not necessarily mean that two pairs of terminals at the switchboard are exclusively devoted to these purposes, for by means of a branch switchboard (or its equivalent, a set of leads ending at convenient points) connection from armature and fields may be had when required, and at another time these points on the switchboard, with their attached leads, will serve for a different connection. It will thus be seen that a laboratory or general purpose switchboard should have much in common with the plug switchboard used in arc

circuit telephone switchboards. With few exceptions each lead to the switchboard descends vertically to its terminal, and all are rubber insulated and protected by tubes, which are secured together in bundles. Referring to Fig. 1, the leads are indicated as connecting to *b* and to the upper half of *c*. The sockets *a* and *b* are of copper, with a tapered hole, which passes right through. By means of a shoulder in the hole drilled through the marble, and nuts and washers behind on the threaded end of the stem of the socket, the latter may be secured in its place and the connection of the lead made to it at the same time on simply screwing up. The upper and lower contacts, *c*, are held together by being secured to flat springs, arranged in a special way. They are somewhat lipped in front, and sufficient clearance is given them in their cylindrical hole. So long as the two halves of *c* are electrically connected it will be seen that *a* and *b* are the actual terminals, and it is into these that the tapered plugs of the connectors are inserted. These connectors are simply pieces of rubber-insulated wire, of different suitable lengths, secured at

each end to the tapered plugs, and with insulating handles.

The use of a wedge consisting of two flat conductors separated by mica, each connected to a wire and suitably mounted, to introduce into a circuit already made up, an ammeter, the current coil of a wattmeter or Thomson balance, or other conductor of low resistance—is borrowed from a similar device in arc switchboards. The two halves of *c* are intended to be thus forced apart when necessary, and it is our experience that absolute continuity of the circuit can always be maintained during the insertion of the ammeter, the ammeter being in parallel between the upper and lower contacts of *c* before the latter are separated. On inserting slowly, the ammeter reading increases steadily from zero to the full amount. In the illustration will be seen an adaptation of the idea which is believed to be new, a Weston shunt is enclosed in an insulating box, from which projects a wedge of two conductors insulated by mica, one secured to each terminal of the shunt. The branch wires to the Weston ammeter, of range 200 amperes, at the top of the left panel, are protected by a rubber tube. In this way the extra resistance brought in by the ammeter is reduced to the least possible. The illustration shows the Weston shunt in the *c* socket of circuit *A2*. In this way one ammeter may be used on every direct current circuit on the board and changes made if necessary as quickly as readings can be taken. If the direction of the current is not right for the ammeter a reversal of the shunt immediately corrects this. Advantage may be taken of this to mark one end of the shunt and thus use it to distinguish instantly the polarity of any current. Two pairs of circuits within reach also allow wedge connectors to be used to obtain current for any other ammeter or wattmeter which may be placed on bracket desks near by. Referring again to Fig 1., *p* and *q* indicate small rubber insulated pressure wires which lead to two contacts in the jack of the same letter and number, mentioned before; thus but for exceptions there would be sixty pairs of such wires. To connect with these jacks three "cords" are brought through the central upright, these terminate each in a metallic circuit plug which may be inserted into any one of the sixty jacks and thereby effectively prolong the corresponding pair of pressure wires to the distant ends of the two light flexible conductors which the "cord" contains. Two of the three lead to the bracket desks already mentioned, where they are intended for voltmeters and the pressure coils of wattmeters. The other one returns again to a reversing switch in the space just below the jacks (a small double throw switch adapted for the purpose); from this switch wires are continued to the Weston direct current voltmeter reading to 150 volts, on the right hand panel.

By this means the voltmeter also may be quickly transferred from one pair of terminals to another and measurements made of potential difference, the polarity being indicated by the position of the reversing switch when reading. When alternating current is used one of the two cords just mentioned must be employed. Suppose now that it is required to measure the power absorbed by the circuit *E4*; a suitable wattmeter being connected to the pressure and current leads it is now only necessary to insert the wedge plug in *E4c*, and the "metallic circuit plug" in jack *E4*.

Provision has been made for several connections to be simultaneously made to the city incandescent circuit (110 volt) by repeating this in five socket sets. When it is desired to connect in parallel in any other

case this is done by the arrangement of paralleling bars shown in Fig. 2. Suppose, for instance, that *B3* are the leads from a dynamo and *E8*, *E9* and *E10* rheostats, and it is desired to absorb the power of the dynamo in these rheostats in parallel, then on connecting *B3* to *C6* and connecting *C7*, *C8* and *C9* to *E8*, *E9* and *E10* respectively (i.e. *a* to *a* and *b* to *b* in each case, remembering that all but the terminals shown in Fig. 2 are like Fig. 1) it will be found on tracing out the connection that they are parallel as desired. A study of Fig. 2 will show that effectively all the *a* connections are on one bar just as the *b* connections are, thus the dynamo and rheostats have their terminals at two common points. The advantage of the arrangement of the figure, however, is that current and power measurements are made possible in all the parallel branches. The other set *D* provides for the possibility of another paralleling operation being conducted at the same time, or by joining the two sets, for paralleling as many as five paths.

But another use may be made of this double set; suppose it is desired to operate a three-phase induction motor from the three-phase terminals of a rotary transformer, and at the same time to measure the electrical power supplied to the motor. Connect the three rotary transformer leads to *C6a*, *C6b*, and *D6a*, and the three motor leads to *C7a*, *C7b*, and *D7a*, interchanging any pair of either if the direction of revolution is not right; this is sufficient for the operation of the motor. To measure the power, however, run a connector from either of the remaining *b* terminals on the *C* side to one of the *b* terminals on the *D* side, then on introducing, as already described, pressure and current connectors at the same time on circuit *C6* and reading on a properly connected wattmeter, then immediately moving both wedge and metallic circuit plug to the corresponding *D6* connections and reading again, the sum of the two readings gives the power (subtracting if reversal is necessary to secure a reading on the scale). The same method of measurement would hold good wherever three wires are used, whatever the system, symmetrical three phase, monocyclic, three wire alternating or direct. The general utility of the jacks for the purpose may be criticized, but here the circuits being limited to 150 volts no danger is felt from this source.

As only a few circuits are likely to be in use at once in a laboratory, only a relatively small number of switches need be provided. These are shown on the

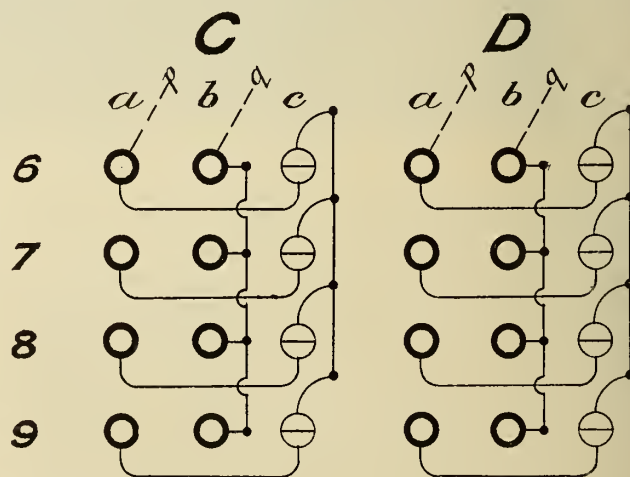
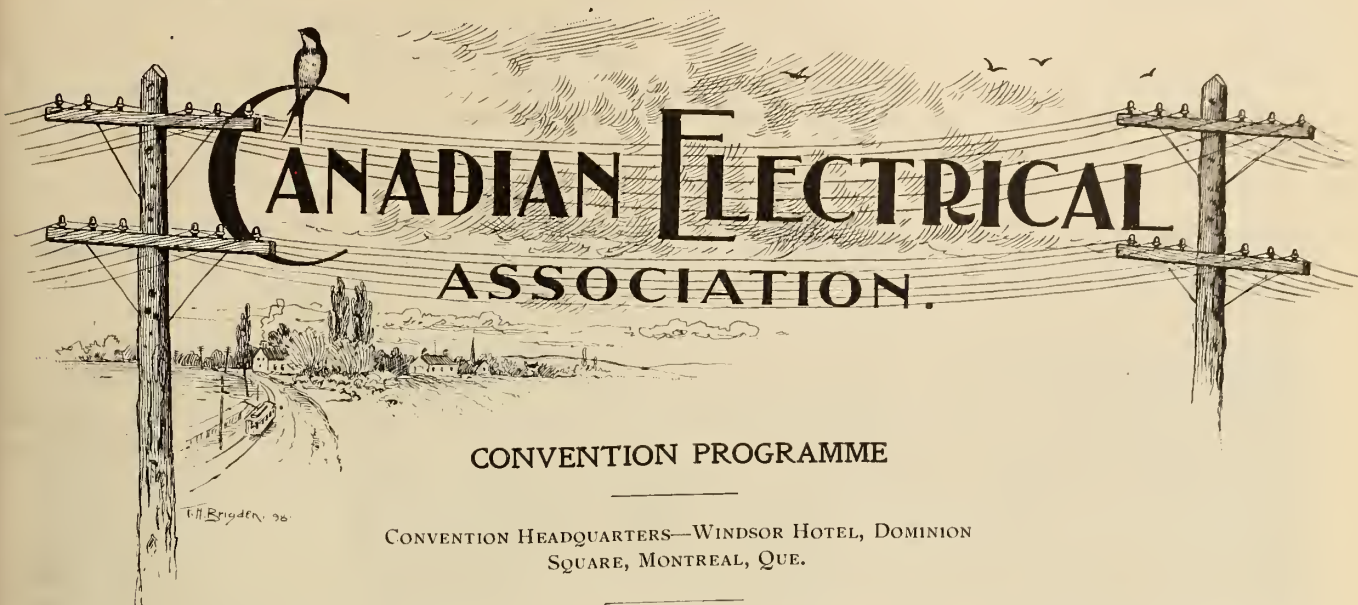


FIG. 2.

outer marble slabs and are double pole, one being double throw and the other single throw. While fuse blocks are arranged behind the switchboard on all circuits where they are needed, there are also two magnetic cut-outs, an "I.T.E." and a "cutter," one at the head of each of the outer marble slabs. These, as well as the switches, are provided each with its own switchboard terminals, so that they may be included in any circuit when required.

It may be added that the rather difficult drilling of the holes was done by the Messrs. Fensom, the brass work fitted by the Toronto Electrical Works, and the switches and outer marble slabs supplied by the Royal Electric Co. The wiring was done by Mr. A. Sanderson.



CONVENTION PROGRAMME

CONVENTION HEADQUARTERS—WINDSOR HOTEL, DOMINION
SQUARE, MONTREAL, QUE.

BUSINESS PROGRAMME.

TUESDAY, JUNE 28TH.

- 9.30 A.M. Meeting of Executive Committee.
10.00 A.M. Opening of first session in Convention Hall, Windsor Hotel.
President's Address.
Reading Minutes of last Meeting.
Secretary-Treasurer's Report.
Reports of Committees and General Business.
2.00 P.M. General Business.
Presentation of Papers.
Discussion.

WEDNESDAY, JUNE 29TH.

- 9.00 A.M. Consideration of Reports of Committees.
Election of Standing Committees.
Selection of Place and Time of next Meeting.
General Business.
Presentation of Papers.
Discussion.

THURSDAY, JUNE 30TH.

- 9.30 A.M. Election of Officers.

LIST OF PAPERS.

- "How to Overcome Some of the Difficulties Encountered by Central Station Men." A. A. Wright, Renfrew, Ont.
(1) "The Unconscious Ownership of an Important Key"—(A Plea for the Introduction of Goods Traffic on our Suburban Tramways). W. T. Bonner, Montreal.
(2) "The Quimby Screw Pump." Dr. J. K. Johnstone, Inspector of Electric Light, Toronto.
"Experiences of an Inspector." W. W. Hopkins, B.Sc., C.E. etc.
"The Electric Current in the Rainy River Gold Mines." F. A. Bowman, M.A., B.E., New Glasgow, N.S.
"The Importance of Proper Methods of Illumination." Louis DeWitt Magie, Montreal.
"Electric Utilization of Water Powers." James Milne, Toronto.
"Economies in the Boiler Room."

SOCIAL FEATURES.

TUESDAY, JUNE 28TH.

- 7.30 P.M.—Trip around Mount Royal by special Park and Island cars, afterwards ascending Incline Railway to lookout on mountain to view the city under illumination.

WEDNESDAY, JUNE 29TH.

- 1.00 P.M.—Visit to (1) Bell Telephone Company's new building; (2) Street Railway Company's power house; (3) power house and works of the Lachine Rapids Hydraulic & Land Company, returning to city at 7.30 p.m.
9.00 P.M.—Annual Association Banquet at Windsor Hotel.

THURSDAY, JUNE 30TH.

- 11.00 A.M.—Visit to McGill University.
1.30 P.M.—Visit to Royal Electric Company's lighting station and factory, then by special G.T. train to visit the works of the Chambly Manufacturing Company at Chambly.

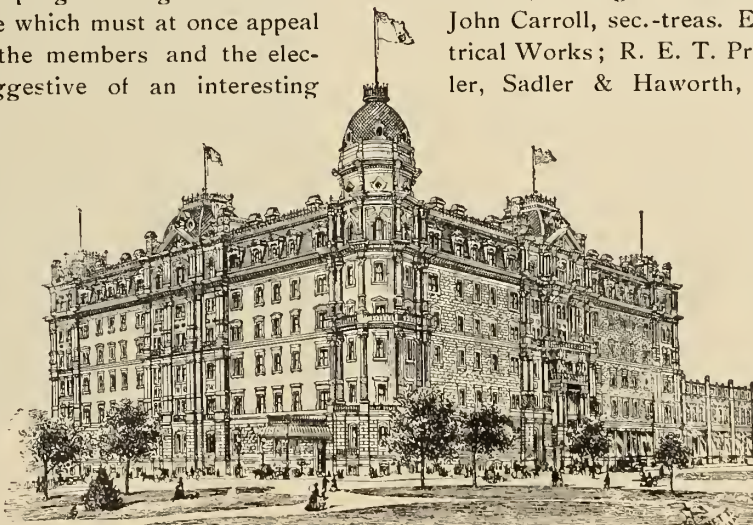


THOSE who have the success of the Canadian Electrical Association at heart must indeed feel gratified that Montreal was chosen as the meeting place for the eighth annual convention of that society. The programme given above is one which must at once appeal to the members and the electrical fraternity as suggestive of an interesting and instructive meeting.

As will be seen, the papers to be presented cover a wide range of subjects, and it is hoped they will provoke discussion, which is one of their most useful purposes. The authors have given much time and labor to their preparation, but their true value can only be extracted by a thorough discussion of the points and claims embodied therein. Copies of the papers are now ready for distribution to members who signify their desire to be supplied with same.

The social features of the convention have been care-

fully arranged by the local committee, the members of which are as follows: William Thompson, consulting engineer; W. H. Browne, manager Royal Electric Company; W. B. Powell, G. N. W. Telegraph Company; L. B. McFarlane, eastern manager Bell Telephone Company; W. T. Bonner, manager Babcock & Wilcox Company; John Carroll, sec.-treas. Eugene F. Phillips Electrical Works; R. E. T. Pringle; Ald. G. W. Sadler, Sadler & Haworth, of Montreal; O. Higman, Inland Revenue Department, Ottawa; A. B. Smith, G.N.W. Telegraph Company, Toronto; F. H. Badger, superintendent Montmorency Light & Power Co., Quebec. The personnel of the committee is itself a sufficient assurance to the members of the Association that the arrangements for the entertainment of the delegates and their friends will be of the most complete character. The visit to the many electrical works, such as the Chambly and Lachine plants, the Royal Electric Company's lighting station, the Bell



CONVENTION HEADQUARTERS—WINDSOR HOTEL, MONTREAL.

Telephone building, etc., cannot fail to interest every visitor.

On the evening of the 29th inst. the annual banquet of the Association will take place at the Windsor Hotel. It will no doubt prove an altogether successful function, and the generator of pleasant mem-

extremities. It was founded on the 8th of May, 1642, by Maisonneuve, a knight of the mediæval school, 107 years after the visit of Jacques Cartier in 1535. Champlain visited the place in 1611 and founded a trading post on the site of the old Custom House Square. The first clearing for the city was made where the present custom house now stands.

Montreal surrendered to the British forces on the 8th of September, 1760, one year after the capture of Quebec. The Americans captured the city in 1775, and it was again secured by the British the following year. From that time forward the growth of the city has been well nigh phenomenal, until to-day it has a population of more than 275,000. It is said that one-half of the population is of French origin.

The principal streets of the city running east and west are Notre Dame,

St. James, Craig, St. Catharine and Dorchester, and on the first three of these are located many of the principal commercial houses and public buildings. The main streets running from the river towards the mountain are St. Denis, St. Lawrence Main and Bleury. The Windsor hotel, the headquarters of the forthcoming convention, is located on the corner of Windsor



VIEW OF THE DOCKS AT MONTREAL.

ories in the minds of those who shall be privileged to attend.

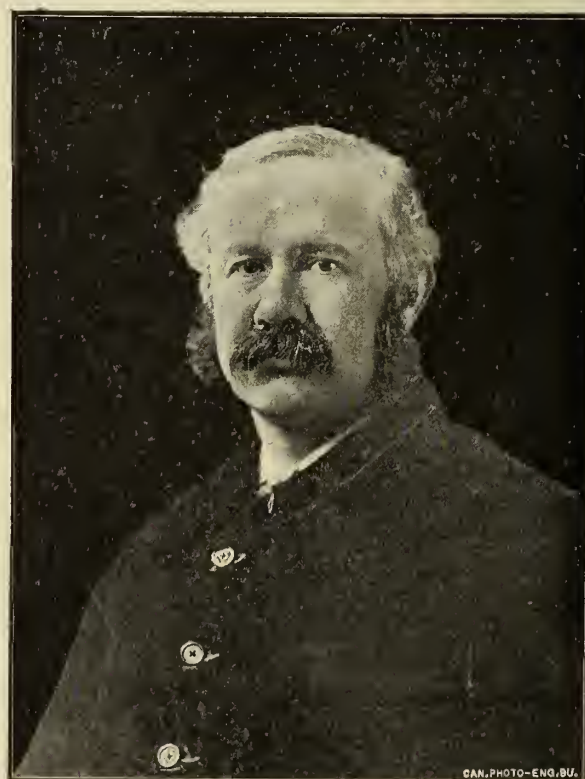
Altogether, the success of the convention would seem to be already assured. A good representation is expected from Ontario, while the local attendance is certain to be greater than at any previous convention. As stated in the programme, arrangements have been made with the Grand Trunk and Canadian Pacific Railway Companies for a rate of fare and one-third for the return trip. Should the present low rates continue, which now seems probable, the return ticket from Toronto will cost only about \$7. This should prove a strong inducement to a good attendance.

The steps taken by some towns and cities in Ontario towards municipal ownership have been the means of increasing interest in the Canadian Electrical Association, the usefulness of which is now acknowledged. Electric light companies have become convinced of the necessity of organization in order to protect their property. There is also the problem of the insulation of electric wires, to meet the demands of the Fire Underwriters' Association. These questions are likely to be fully considered at the forthcoming convention.

THE CITY OF MONTREAL.

Situated at the head of ocean navigation, and as the commercial metropolis of the Dominion, Montreal occupies an unique position among the cities of Canada. Within its borders are located great commercial institutions; public and educational buildings unsurpassed on the continent of America; churches of wonderful massiveness and architectural beauty; a number of public parks and squares; these, with other equally important features, make the city one of the most interesting, as well as instructive, in the world.

A few words of historical reference are necessary to an understanding of the many points of interest, and of the great strides that have been made by the city in a commercial way. As all Canadians know, Montreal is built on an island formed by the Ottawa river debouching into the River St. Lawrence, at its western and eastern



PROF. BOVEY,

Dean Faculty of Applied Science, McGill University.

and St. Catharine streets, overlooking Dominion Square, and near the C.P.R. and G. T. R. stations, of which illustrations are given in another part of this paper.

The churches of Montreal are one of the greatest attractions to visitors. Foremost of these is St. Peter's Cathedral, on Dominion Square, and which may be viewed from the Windsor Hotel. It is being built after

the model of St. Peter's in Rome, was commenced in 1868, and is yet in course of completion. The church Notre Dame, opposite Place d'Armes Square, is also built after the style of a church in Paris, and is said to have cost \$6,000,000. The oldest church in the city is Notre Dame de Bonsecours, erected in 1771.

separate structures—the Engineering building, the Physics building, and the workshops. Prof. Bovey, whose portrait appears on the opposite page, is Dean of this faculty, and Mr. L. A. Herdt, E.E., Ma.E., Demonstrator in Electrical Engineering, with charge of the electric light plant. A description of the electrical



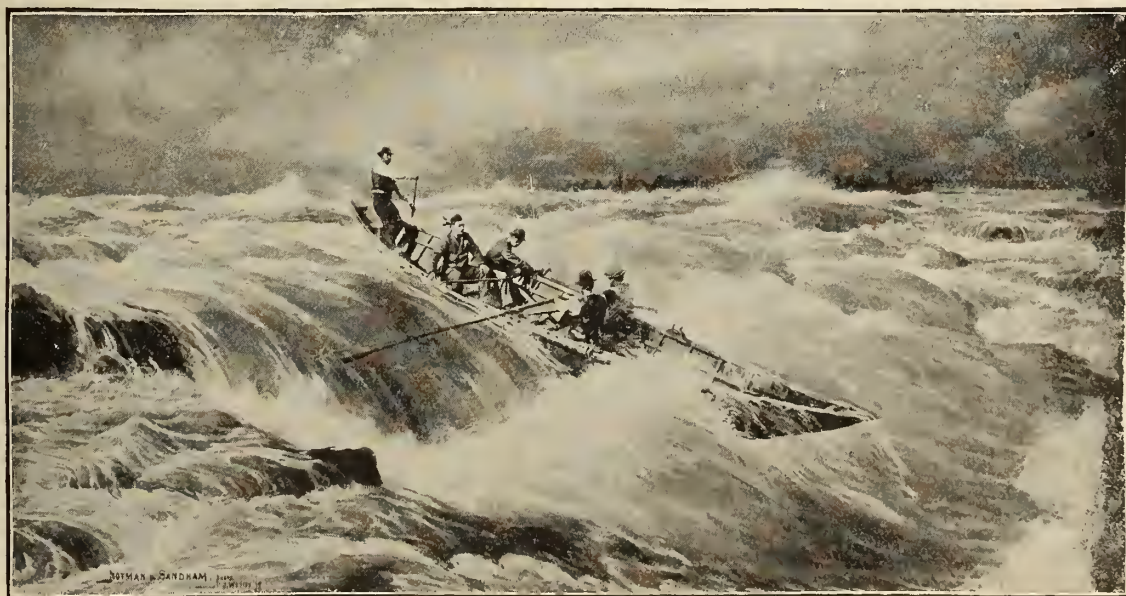
VIEW OF VICTORIA SQUARE, MONTREAL.

McGill University, which is intended to be visited by the delegates to the convention, is one of the grandest educational institutions in the world. Forty-seven acres of land, on which the buildings stand, together with the sum of ten thousand pounds, was bequeathed by Hon. James McGill to the "Royal Institution for the Advancement of Learning," to establish a college for the

laboratory appeared in our May issue. We can safely predict that visitors will here find much of interest.

Among the public buildings of importance in Montreal might be mentioned the Court House, Bonsecours market, and the City Hall.

The three most noted squares are the Dominion, Victoria and Place d'Armes, views of which are shown.



BOAT SHOOTING LACHINE RAPIDS, NEAR MONTREAL.

purposes of education. With these funds the present institution was commenced, and, by donations received since, there have been erected large and thoroughly equipped buildings for the different branches of learning. The department of the Faculty of Applied Science, in which members of the Canadian Electrical Association will be most interested, consists of three

Reference has already been made to the first of these. Victoria square is situated between McGill street and Beaver Hall hill, and upon it is a colossal bronze statue of Queen Victoria. Place d'Armes, between Notre Dame and St. James streets, is surrounded on four sides by important buildings, the New York Life, in which are the Montreal offices of this journal,

forming one section. Mount Royal Park, which may be reached by the Incline railway shown in the accompanying engraving, covers 430 acres of ground, and rises over 700 feet above the level of the St. Lawrence river.

One of the most important engineering works yet undertaken, the rebuilding of the Victoria bridge, is now



INCLINE RAILWAY TO MOUNT ROYAL PARK.

in progress. The old Victoria bridge, at the time of its erection in 1859, was the greatest in the world, being nearly two miles in length. It is said to have cost \$6,000,000, and to have occupied nearly six years in building, though used only by the Grand Trunk Railway. The new bridge will have tracks for steam railways and electric cars, besides a road for vehicles and sidewalks for pedestrians, a feature which will be greatly appreciated by the public. During construction traffic has continued incessantly, this being made possible by the utilization of portions of the old bridge.

ELECTRICAL FEATURES.

Electrically, Montreal is beyond doubt the most attractive city in the Dominion. It is fitting, perhaps, that reference should first be made to the electric railways, of which there are three distinct systems, viz., the Montreal Street Railway, Montreal Park and Island Railway, and Montreal Belt Line Railway. Six years ago the Montreal Street Railway was changed to electric traction, and the company have now in operation over eighty miles of road. The rolling stock consists of nearly 300 motors and trailers. The power house, on William street, is 290 x 233 feet. In the engine and dynamo room are located twelve Edison generators of 200 k. w. capacity each, six multipolar generators of 300 k.w. capacity, and a 4,500 h.p. Laurie engine installed last summer. This engine replaced six Corliss compound engines of 600 h.p. each, which were in use at the time the photograph was taken from which the accompanying illustration of the power station was made. An interesting feature of this installation is the switchboard, which is 60 feet long and

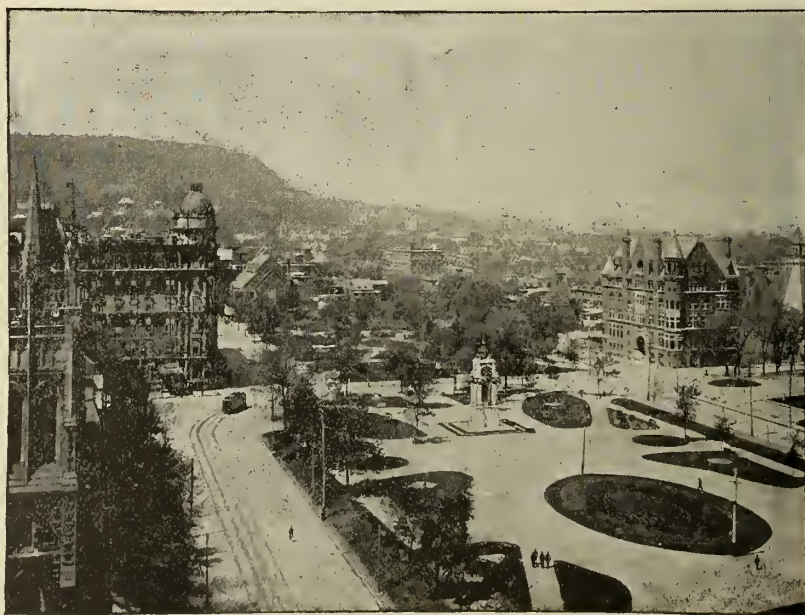
11 feet high, constructed of terra cotta lumber. The entire equipment is very complete and interesting. The offices of the company are at the corner of Craig street and Place d'Armes, Mr. F. L. Wanklyn, whose portrait we give, being general manager.

The Montreal Park and Island Railway affords the means of visiting the many beautiful suburbs of Montreal, passing, as it does, through a most picturesque country. There are two main lines, with some twenty miles of track. The Sault-au-Recollet line runs up St. Lawrence street, thence straight across the country to



PLACE D'ARMES SQUARE, MONTREAL, SHOWING NOTRE DAME CATHEDRAL.

Sault-au-Recollet, or Back River. The Cote-des-Neiges, or Outremont line runs up Bleury street and Park avenue, through Montreal annex, Cote-des-Neiges, Mount Royal Vale, and Notre-Dame-de-Graces, making a complete circuit of both mountains and connecting with the lines of the Montreal Street Railway at Westmount. Places of interest along the route are the Monument National, Shamrock lacrosse grounds, Convent of the Sacred Heart, Hotel Dieu, Royal Victoria Hospital, Monklands, ruins of Villa Maria Convent,



DOMINION SQUARE, MONTREAL.

and numerous historical landmarks. The power station of the company is located at Mile End, although it is intended to build a larger generating station when all the proposed lines of the company have been completed. Mr. Chas. A. E. Carr, whose genial countenance is portrayed on another page, is general manager.

The system of the Montreal Belt Line Railway has

recently been put in operation, and comprises thirteen miles of track. It is intended to serve the lower part of Montreal Island. The line leaves the Canadian Pacific Railway at Hochelaga, passes through the municipalities of Maisonneuve, Longue Point and Point aux Trembles, and, following the course of the St. Lawrence

So much for the electric railway systems. Turning to another branch of the electrical industry, viz., light and power, we find within the city of Montreal and in its immediate vicinity the two great hydraulic-electric plants of the Chambly Manufacturing Company and the



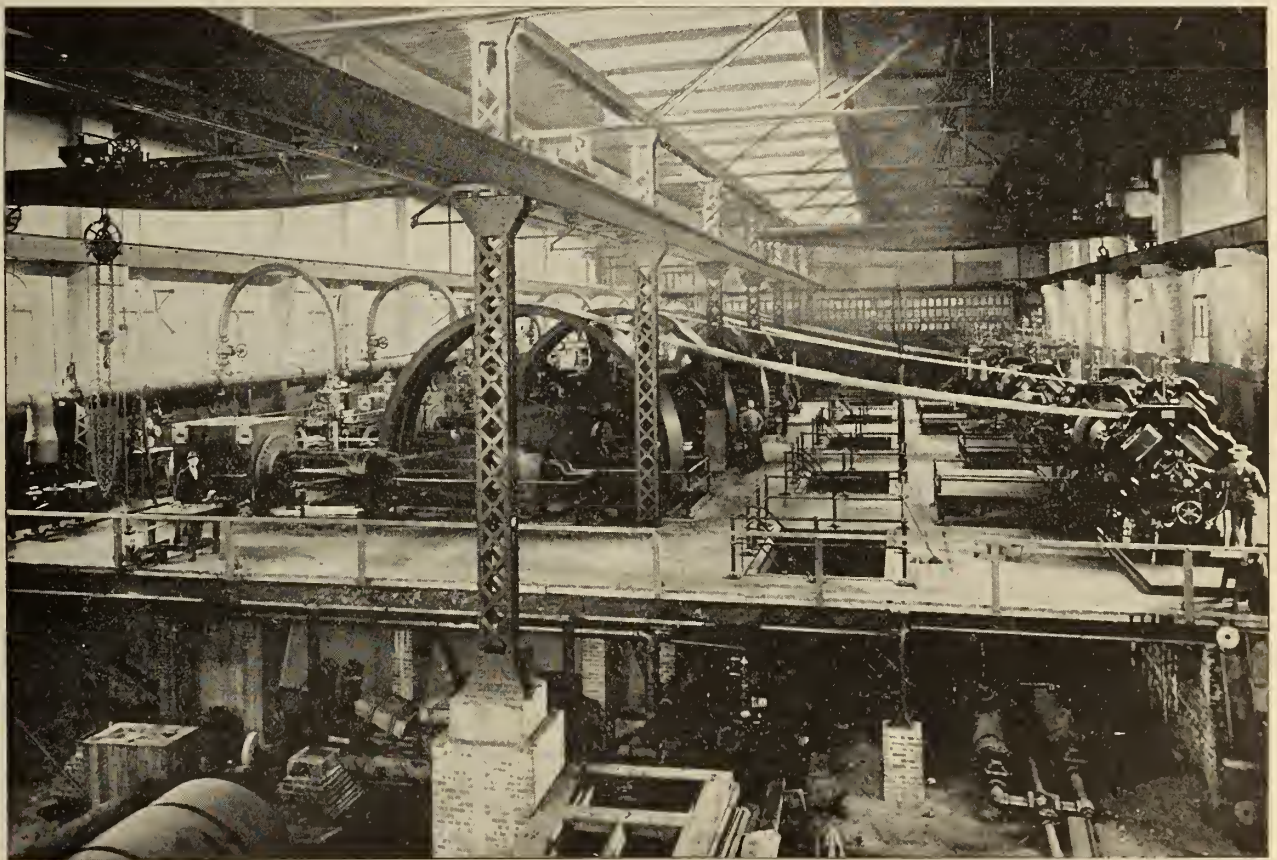
MR. W. L. WANKLYN,
Manager Montreal Street Railway.



MR. C. A. E. CARR,
Manager Montreal Park and Island Railway.

river, reaches Bout d'Isle. At this point the cars are connected by a steam ferry with the town of Charlemagne and other points. The power house is built near the centre of the line, and contains two C.G.E. generators of 200 to 325 kilowatt, three Goldie & McCulloch compound condensing Wheelock engines,

Lachine Rapids Hydraulic and Land Company, an inspection of which is included in the convention programme. Chambly is the headquarters of one of the most comprehensive power and transmission schemes yet undertaken on the continent, and which is now



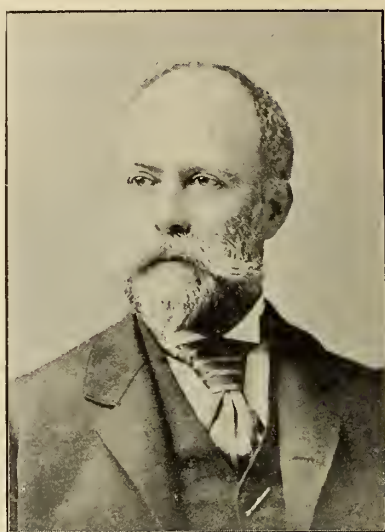
ENGINE AND DYNAMO ROOM, MONTREAL STREET RAILWAY COMPANY'S POWER HOUSE.

aggregating 700 h.p., with necessary boilers and other equipment. The cars comprise nine open and four closed, in addition to an electric freight locomotive. The manager of the road is Mr. J. P. Mullarky. Mr. John Rowley is superintendent, Mr. Robert Welsford, engineer, and Mr. C. H. Wright, son of Mr. A. A. Wright, of Renfrew, electrician.

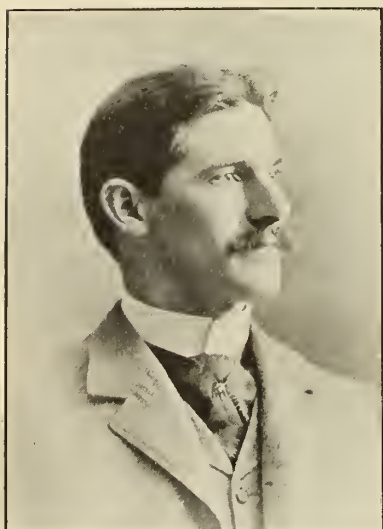
nearing completion. The source of power is a large concrete dam and generating station on the Richelieu river at the village of that name, 25 miles distant from Montreal. It is intended to transmit 20,000 horse power to the city for incandescent and arc lighting and direct current motor service, the main power transmission line to end in the electric light station of the



MR. WM. THOMPSON, Chairman, Montreal.



MR. W. H. BROWNE, Montreal.



MR. W. T. BONNER, Montreal.



MR. O. HIGMAN, Ottawa.



MR. L. B. MCFARLANE, Montreal.

MEMBERS OF LOCAL COMMITTEE—CANADIAN ELECTRICAL ASSOCIATION CONVENTION, MONTREAL, 1898.

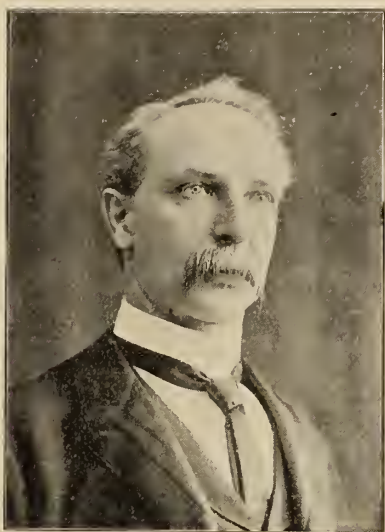
Royal Electric Company, by whom the work is being carried out. From early days there was a wooden dam between Richelieu village on the one side of the river and Chambly on the other. This has been replaced by a new structure, which is one of the finest examples of hydraulic engineering on the continent. It consists of a massive concrete dam 2,000 feet long, in which, as an integral part, is built the power house. The dam consists of three portions, two of which run perpendicular across the course of the river, while the third and middle part is parallel with it. In the lower third of the dam is built the power house, a structure of steel beams and brick walls, 308 x 51 feet. The upper level will contain the switchboard, controlling devices and offices. There will be 32 turbines, each 46 inches in diameter and of 660 h.p. capacity, making a total of over 21,000 h.p. Each gang of four turbines will be directly connected to a 2,000 k.w. "S.K.C." generator, giving two phase current at 60 cycles per second and generating 12,500 volts. A view of one of these generators is shown in the advertisement of the Royal Electric Company on another page. They are of the induction type, and the insulation is necessarily most massive and substantial. Among the many interesting features of this plant is the novel method of carrying the wires over the new Victoria bridge.

The works of the Lachine Rapids Hydraulic & Land

Company were completed in the fall of last year. As implied by the name, the water of the Lachine rapids is utilized. The hydraulic machinery, when all is installed, will consist of 72 Victor wheels of 300 h.p., and the electrical installation of twelve 750 k.w. C.G.E. three phase generators, direct connected to six water wheels and operating at 4,400 volts at 175 revolutions. The company practically have four stations. Their sub-station at the corner of McCord and Seminary streets, and the Standard Light and Power Company's station both obtain power from the rapids, being equipped with direct current apparatus driven by synchronous motors. The sub-station of the Citizen's Light and Power Company at Cote St. Paul was destroyed by fire a few months ago, but is now being rebuilt. The Lachine Company also supply power to the Temple Electric Company, in which they have a controlling interest. A fine new switchboard has recently been purchased. It is made of blue Vermont marble, with specially designed switches.

The lighting and power stations of the Royal Electric Company have been entirely reconstructed on the most improved methods within the last two years. These, together with the extensive works of this company for the manufacture of electrical apparatus, will doubtless prove a special attraction to central station managers.

The fine new building of the Bell Telephone Company



ALD. G. W. SADLER, Montreal.



MR. A. B. SMITH, Toronto.



MR. W. B. POWELL, Montreal.



MR. JOHN CARROLL, Montreal.]



MR. R. E. T. PRINGLE, Montreal.

MEMBERS OF LOCAL COMMITTEE—CANADIAN ELECTRICAL ASSOCIATION CONVENTION, MONTREAL, 1898.

on Notre Dame street will well repay a visit. The equipment of the exchange is most complete and up to date, as becomes the headquarters of the company. The head offices of the G.N.W. and C.P.R. Telegraph Companies, located on St. Paul street, within a block of each other, should also be visited.

Nor should we overlook the manufacturers of and dealers in electrical supplies, who, through the medium of this journal, extend a hearty welcome to members of the Canadian Electrical Association and their friends to visit them. Ness, McLaren & Bate will be found in new premises at 419 St. James street; Royal Electric Company on Queen street; Canadian General Electric Company at 1802 Notre Dame street; R. E. T. Pringle at 216 St. James street; John Forman at 644 Craig street; Alex. Barrie & Co., manufacturer electric wires, at 589 St. Paul street; Munderloh & Company at 61 St. Sulpice street; Montreal Electric Company at 1898 Notre Dame street; the Electric Repair & Contracting Company at 621 Lagauchetiere street, and Fred Thomson & Co. at 7 Chenneville street. The factory of the Eugene F. Phillips Electrical Works, of which Mr. John Carroll is manager, is at Point St. Charles. E. A. Wallberg, sales agent for the Kingsley water tube boiler, is located in the Bell Telephone building. The J. C. McLaren Belting Company, 294 St. James street, will also keep open house during the convention.

Visitors should not fail to inspect the permanent exhibit of steam plant accessories at the offices of Babcock & Wilcox, Limited, 202 St. James street. The building is better known as the Mechanics' Institute, and is situated on the corner of St. Peter street. All Windsor and St. Lawrence, Notre Dame and P. and I. Lachine cars pass the door. In addition to installing a full sized working model of one of their forged steel boilers, erected with brick setting on structural iron foundation resting on concrete footings in the basement, Babcock & Wilcox exhibit in working order, automatic damper regulators, recording pressure and draught gauges, gauge testers, safety valves, steam traps, feed water filters, expansion joints, and all other steam plant accessories. Of the thirty odd thousand horse power of boilers listed on the official inspector's records in Montreal, Babcock & Wilcox have supplied over 8,000 h. p., or 25 per cent. At the Queen street and Sohmer Park stations of the Royal Electric Co., Montreal Street Railway, William Street Power House, Bell Telephone building, New York Life building, McGill College, Notre Dame Cathedral and many other places, visitors will find large installations of Babcock & Wilcox boilers.

Some of the natural, artificial and electrical features of Montreal have been briefly outlined in this article; there are others of equal interest. What has been written should be sufficient to induce every member of the Canadian Electrical Association to endeavor to be present at the forthcoming convention and participate in the programme which has been prepared.

BELL TELEPHONE COMPANY'S LONG DISTANCE LINES.

THE accompanying map shows the long distance lines and offices of the Bell Telephone Company in the provinces of Ontario and Quebec, for particulars of which the reader is referred to the article in our April issue under the heading "Long Distance Telephony in Canada." The company have now in operation in these provinces 6,095 miles of poles, bearing 16,567 miles of wire. Connections have been established with

most ingenious and useful device called the calculagraph. The purpose of this little machine, of which an illustration is given below, is to check automatically the time occupied by a conversation. It is encased in a stand, the face of the machine bearing an exact resemblance to an ordinary clock. Two dials on the left indicate elapsed time; the first dial and pointer make a complete revolution in five minutes, and the smallest division represents one-quarter of a minute. The second dial and pointer make a complete revolution in



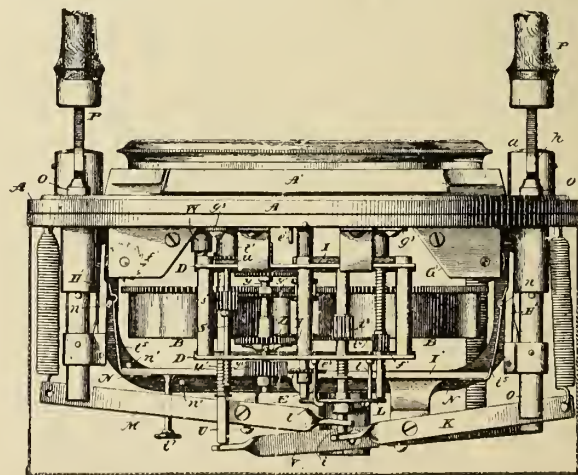
MAP SHOWING BELL T

the long distance system of the American Telegraph and Telephone Company and affiliated companies in the United States, affording a system of direct communication as far south as Virginia and Tennessee, and from the cities and towns of the Atlantic seaboard westward to Nebraska.

The efficient service now afforded by long distance telephone lines has been quickly recognized by the commercial world, the putting into operation of the service appearing to immediately create new business—that which could not be done either by mail or telegraph. We are informed by the Bell company that conversations are now frequent from Ottawa to Baltimore, and from Montreal to Cincinnati, Pittsburg, Philadelphia, Chicago, Portland, Richmond, Virginia, Evanston, Illinois, and other distant points.

In order to make the service as efficient as possible, and also to ensure perfect accuracy in calculating the time for which a customer is charged, the Bell Telephone Company have recently equipped all their principal long distance exchanges in Canada with a novel but

one hour, and the dial is divided into periods of five minutes each. The method of using is as follows: At the beginning of a message a blank card or ticket is in-



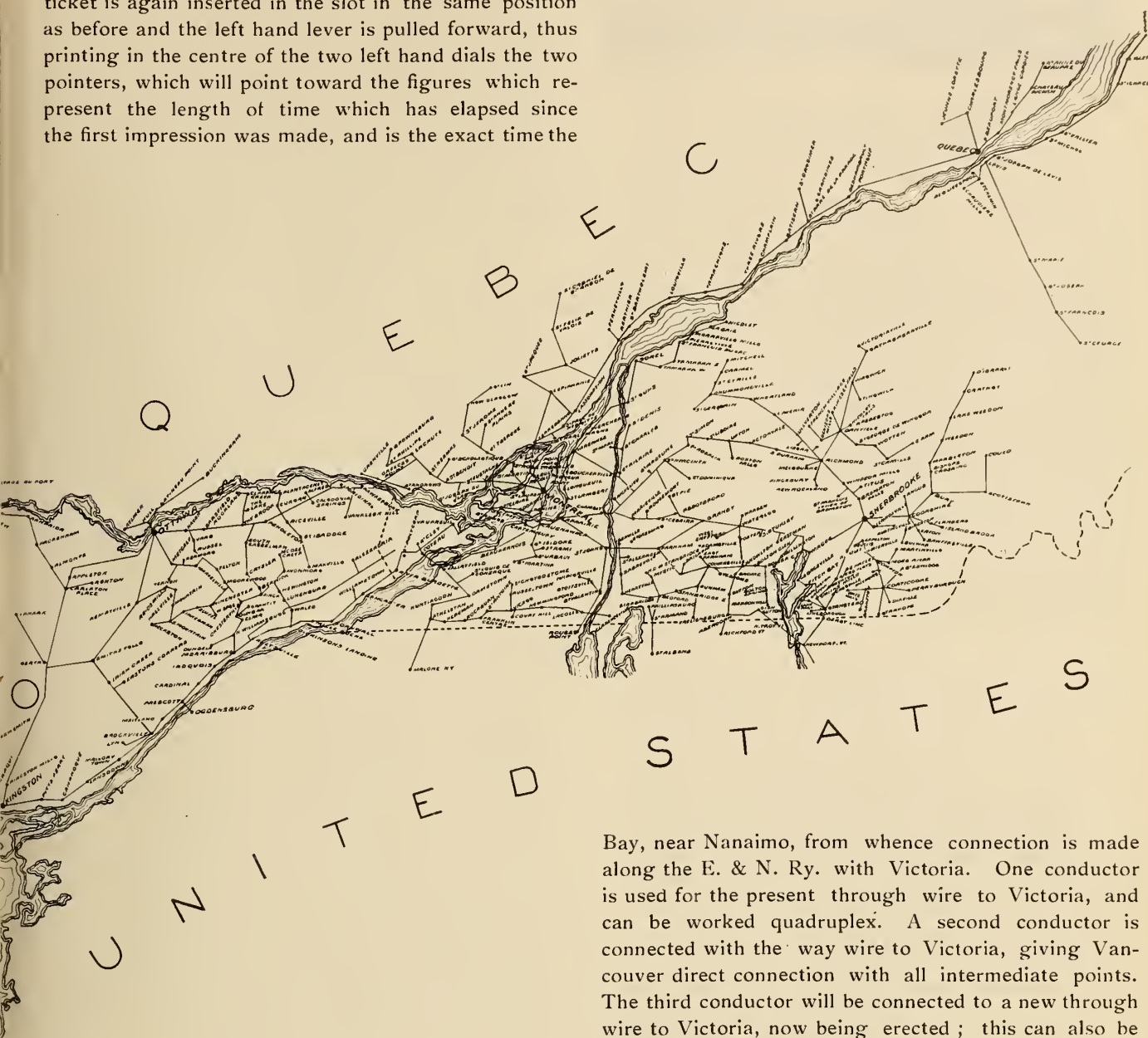
BELL TELEPHONE COMPANY'S CALCULAGRAPH.

serted in the slot at the front of the instrument against the guide, and is shoved to the right until it fits in the

corner ; the right hand lever is then pushed backward and forward ; this records the time of day and also makes an impression of the two dials at the left, but not of the pointers. At the conclusion of the message the ticket is again inserted in the slot in the same position as before and the left hand lever is pulled forward, thus printing in the centre of the two left hand dials the two pointers, which will point toward the figures which represent the length of time which has elapsed since the first impression was made, and is the exact time the

to go forward by the new C.P.R. steamship "Tartar," which had been purchased for the Klondyke travel.

This cable was successfully laid on April 8th, directly from the steamship, from Vancouver city to Departure



LONG DISTANCE LINES.

speaker has occupied the wire. The time is guaranteed to be accurate, the clock running continually, no matter whether any person is speaking or not. The device, which has been patented, has proved a great boon to operators as well as to the company.

C. P. R. CABLES IN BRITISH COLUMBIA.

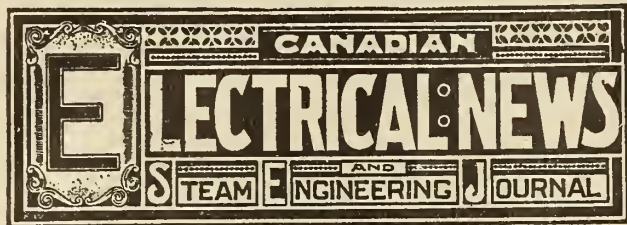
THE telegraph business at Victoria, B. C., increased so largely during the past year that the single conductor cable across the gulf was found insufficient to carry it. Owing to some injuries received through contact with electric light wires in Vancouver, the cable could only be worked duplex. In addition to this, part of the line was built through the woods and was subject to interruptions from the severe wind storms which sweep across that district. Last winter the Canadian Pacific Railway's Telegraph Department ordered a new three conductor cable from the Telegraph Construction and Maintenance Co., London, Eng. The factory was worked night and day and the cable completed in time

Bay, near Nanaimo, from whence connection is made along the E. & N. Ry. with Victoria. One conductor is used for the present through wire to Victoria, and can be worked quadruplex. A second conductor is connected with the way wire to Victoria, giving Vancouver direct connection with all intermediate points. The third conductor will be connected to a new through wire to Victoria, now being erected ; this can also be worked quadruplex, so that in emergency nine circuits can be utilized between Vancouver and Victoria. The old cable has been picked up, all faults cut out, some new single conductor cable added, and was laid on May 21st between Beecher Bay on Vancouver Island and Crescent Bay in Washington. Land lines will connect this with Victoria and Seattle, and, by the end of June, Victoria will have an alternate route. A few years ago there was a cable direct from Victoria to New Dungeness, but it had to be abandoned owing to the armour being destroyed by galvanic action, caused by copper veins in the bottom of the straits. On account of these veins the cable was not replaced, but it is hoped that the new route, via Beecher Bay, will be free from them.

The work of laying and picking up these cables was done under the superintendence of Mr. F. B. Gerrard, of the Commercial Cable Co.'s staff.

The Jenckes Machine Co., of Sherbrooke, Que., have equipped the Athabasca mine, Nelson, B.C., with complete hoisting outfit and boiler.

D. S. McArthur & Co., of Nelson, B. C., are developing their properties, and recently purchased through the Rossland branch of the Jenckes Machine Co. one of their complete hoisting plants.



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Electric Roads in New York.

The Metropolitan Street Railway Company, and the Third Avenue Railroad Company, of New York, have made application to the State Railroad Commission for permission to change the motive power on the various lines not now operated by electricity. It is said that these changes will cost thirty million dollars, and will apply to about 150 miles of road. It is probable that the underground conduit will be adopted. When the improvements are completed both horse and cable power will be done away with.

Central Stations As Fire Risks.

A DETAILED summary of the fire losses of Canada will, we believe, show that central stations for electric light and power are by no means undesirable risks for insurance companies. Comparatively few stations are destroyed or seriously injured by fire. Indeed it would seem that, owing to their operation at night, when the greater percentage of fires occur, the danger is to a large extent minimized. This being the case it is probable that all central station managers have not given sufficient attention to the adoption of proper methods for the prevention of fire. The Underwriters' Association is now having an inspection made of central stations in Ontario, with a view to learning how far they meet the

demands of the association. It is therefore in the interest of the electrical industry that reasonable precautions against fire be taken by the owners of light and power stations. In this connection we might point out the necessity for a more thorough understanding between the Underwriters' Association and the electrical companies. While it is desirable that the demands of the underwriters should be complied with in so far as is expedient, some of their requirements are believed to cause unnecessary hardship. This not only applies to central stations, but also to electric wiring of buildings. We hope that this subject will be brought up and fully discussed at the forthcoming convention of the Canadian Electrical Association.

Electrical Conventions in Chicago.

THE National Electric Light Association and the Illinois Street Railway Association held their annual conventions in Chicago on June 7th, 8th and 9th. At the former Mr. W. McLea Walbank, of Montreal, read a paper on "The Cost of Producing Electric Power by Water Power from Lachine Rapids." A paper on "General Distribution from Central Stations by Alternating Currents," was presented by Mr. H. A. Wagner, of St. Louis, and a companion paper on "General Distribution from Central Stations by Alternating Currents," by Mr. Louis A. Ferguson, of Chicago. An interesting feature of the programme was an illustrated lecture on "Electricity Direct from Coal," by Mr. Joseph Wetzler, of New York.

Cost of Niagara Power.

IN view of the agitation by a section of the press and community in favor of attempting to bring electric power from Niagara Falls to Toronto, interest attaches to a schedule of charges recently adopted by the Cataract Power and Conduit Co. for power delivered in Buffalo, the rates being for three-phase alternating current delivered on the premises of the user at a potential of 2,200 volts:—
For use not exceeding 1,000 units, two cents per unit;
for use exceeding 1,000 units, but not exceeding 2,000 units, the rate shall be, for 1,000 units two cents per unit, and for the excess one and five-tenths cents per unit;
for use exceeding 2,000 units, but not exceeding 3,000 units, the rate shall be, for 2,000 units one and five-tenths cents per unit, and for the excess one and two-tenths cents per unit;
for use exceeding 3,000 units, but not exceeding 5,000 units, the rate shall be, for 3,000 units one and two-tenths per unit, and for the excess one cent per unit;
for use exceeding 5,000 units, but not exceeding 10,000 units, the rate shall be, for 5,000 units one cent per unit, and for the excess eight-tenths of a cent per unit;
for use exceeding 10,000 units, but not exceeding 20,000 units, the rate shall be, for 10,000 units eight-tenths of a cent per unit, and for the excess seventy-five hundredths of a cent per unit;
for use exceeding 20,000 units, but not exceeding 40,000 units, the rate shall be, for 20,000 units seventy-five hundredths of a cent per unit, and for the excess seven-tenths of a cent per unit;
for use exceeding 40,000 units, but not exceeding 80,000 units, the rate shall be, for 40,000 units seven-tenths of a cent per unit, and for the excess sixty-six hundredths of a cent per unit;
for use exceeding 80,000 units, the rate shall be, for 80,000 units sixty-six hundredths of a cent per unit, and for the excess sixty-four hundredths of a cent per unit. There will be an additional charge for "service" of about 75 cents per horse power per month.

CORROSIVE AND SCALE-FORMING AGENTS IN BOILER FEED WATERS.

By WM. THOMPSON.

[ARTICLE 6].

Having considered the scale forming properties of various impurities contained in natural waters, it naturally now requires our attention to be drawn to remedial measures. This we can only discuss in a general way, since conditions of use and impurities in feed waters vary so widely; it is obviously impossible to lay down any single method to suit all cases. Perfectly satisfactory results can only be obtained by individual examinations of each case, taking into consideration not only condition and nature of impurities in feed waters, but also the condition of service and style of boilers or other heating apparatus in use.

While we cannot lay down a rule and formula adapted to each case, we can, at least, intelligently discuss the nature of the reaction it is our desire to bring about, and in this way, I hope, enable the engineer to have reliable data at hand for his guidance.

As already pointed out during the early stages of these articles, the solid impurities contained in the feed water may be in either of two conditions—suspended mechanically, or held in solution. The first of these has quite as important a bearing upon final results as has the latter, and requires just as careful consideration. Since, however, matter held in mechanical suspension requires nothing but mechanical treatment or filtration to effect removal, the question does not involve any serious difficulty. The writer cannot impress too strongly, however, upon his readers the very great importance that this kind of impurity has upon formation of scale. It is comparatively easy in many districts, for various reasons, for the pumps to be continually delivering to the boilers varying quantities of finely divided clay, sand, etc., when water on surface of source of supply appears to be perfectly clear, and presence of such impurities is not even suspected until the engineer finds his boilers coated with thick scale of a most dangerous type. Where there is the slightest danger of anything like this occurring, engineers should insist upon a first-class filtering medium being placed between source of supply and boilers, and small first cost of a real first-class article of this kind will be amply repaid in a very short time.

The idea that any kind of water will do for boiler feed purposes so long as it is "wet" is far too prevalent. The presence of such impurities as are usually met with in mechanical suspension has a very important bearing on scale formation, especially so in the presence of salts of lime and magnesia, and the extraction of matter held in mechanical suspension in very many cases largely tends not only to reduce, but to actually prevent the formation of scale, and the first important requirement necessary for the building up of a good feed water is that it should be clean. As a matter of fact, insoluble matter in suspension should in no case be allowed to exceed .5 grains per gallon. If care and judgment are exercised a good filter can be easily secured, set up, and kept clean, and a very large proportion of the matter held in mechanical suspension removed.

Impurities in solution are of quite a different class, inasmuch as they cannot be extracted by mere mechanical filtration, since by being in solution in the water they will pass through the finest filter, and as a consequence before they can be extracted a change of state must take place, and they must be changed from soluble to insoluble salts, whereby they appear in condition first mentioned and in a position to be extracted by purely mechanical means.

Before proceeding to discuss how this can be brought about, I wish briefly to refer to my first article on this subject dealing with the application of electrical current for prevention of corrosion. A great deal has been claimed by various inventors and writers as to the adaptability of methods of this kind for preventing the formation of scale and effecting its removal after formation. In some instances remarkable success was attained, in many others complete failure resulted. The method has not been universally successful, nor can it be, for many reasons.

I have already pointed out that there are certain scales such as those formed from the carbonates of lime and magnesia that are not very compact, but porous and easily penetrated by the water, consequently the water easily reaches the boiler shell, and when brought into contact with a voltaic current decomposition of the water as an electrolyte sets in, and the hydrogen gas bubbles which form on the iron plate very soon form a thin film of hydrogen gas, interposed between the scale and the plate; as a consequence, scale having poor adhesive qualities soon peels off. Such a result cannot be obtained except in the presence of fairly pure carbonate scale.

Other scales such as are formed from carbonate of lime and organic matter, sulphate of lime, etc., are hard, compact, tenacious in their hold upon iron, and quite impervious to water. Under such conditions as these decomposition of the water cannot take place in contact with the plate, and consequently the thin film of hydrogen gas cannot form between the boiler and the plate.

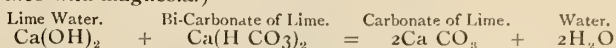
The methods usually adopted to prevent the formation of scale are to render the scale forming impurities insoluble by physical or chemical changes, thus precipitating impurities either previous to or after reaching boilers. It will be readily seen that before treatment of this kind can be effective certain precautions must be taken.

First—precipitate so formed must be of such a nature that it will not harden or bind together into scale; next, chemical compounds added must also be of such a nature that they themselves will neither form scale nor yet attack the boiler parts, as with either of these it is quite possible to get, as a final result, a condition of affairs worse in effect than would result from impurities originally existing.

A process for softening water, originating from Scotland and

known as the Porter-Clark process, may here be referred to as a very useful method for improving feed waters containing the soluble bi-carbonates of lime and magnesia.

This method consists essentially in adding to the feed water a quantity of lime water which first combines with free carbonic acid to form bi-carbonate of lime, and then combining with the excess of carbonic acid contained in the bi-carbonate thus formed as with the excess of carbonic acid already existing as bi-carbonate of lime and magnesia—this final reaction is represented by following equation (in the case of lime salts, a similar reaction taking place with magnesia.)

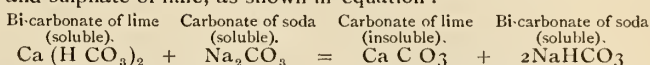


Both the carbonate of lime and magnesia are insoluble at 211° F., and nearly so at 60° F., so that the separation of the precipitate becomes mechanically possible.

As will readily be seen, however, care must be taken to add just the quantity of lime required to effect precipitation of the bi-carbonate, as carbonate or calcium hydroxide will pass on to the boiler and deposit lime on the boiler parts as evaporation proceeds, and if in any great excess a worse scale will be formed than would have been formed if original matter had been allowed to deposit in the boiler. Moreover, since action of lime water is limited to excess of carbonic acid, free or combined with lime and magnesia as bi-carbonates, no reaction will set in between sulphate of lime and lime water, consequently use of this process is limited to waters rich in bi-carbonates, and may be easily detrimental if applied to waters containing much sulphate of lime, particularly if any excess is added, as then the whole of the essential requirements for the formation of a hard compact scale would be present.

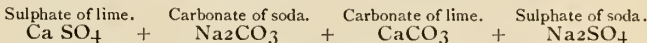
It was originally my intention to show the reaction that would set up between a number of the many compounds on the market, but I find to do this, subject will become unreasonably long. I will then confine myself to a few of the most commonly used substances.

Possibly the chief of these is common hydrated carbonate of soda, or what is commercially known as "sal soda." This compound is largely used for softening water both of temporary and permanent hardness, reactions settling in with both bi-carbonate and sulphate of lime, as shown in equation:

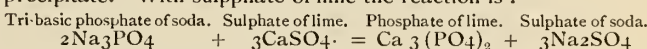


In this case the basic carbonate of soda absorbs or combines with the excess of carbonic acid combined with carbonate of lime and soluble bi-carbonate of soda, and insoluble carbonate of lime is formed. (Note, the reaction with the magnesia salts is similar.)

A reaction also sets in between the sulphate of lime present and the carbonate of soda; thus:



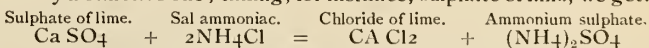
Another commonly used and useful reagent is the tribasic phosphate of soda, which is in many cases to be recommended as a good reagent, its chief property being the ease with which the reaction sets in and the entirely unhardenable properties of the precipitate. With sulphate of lime the reaction is:



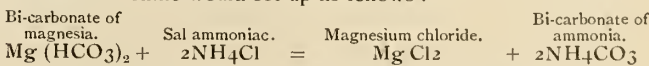
The chief objection to use of chemical compounds of this type is their property of throwing precipitates down, which, if allowed to accumulate, become very troublesome, and, to overcome this, frequent efforts are being made to introduce compounds that will bring about a chemical change but leave the product soluble in water. A great deal may be said for and against use of compounds of this kind—particularly against.

Many compounds of this nature contain a compound known as "sal ammoniac," a salt known in chemistry as chloride of ammonia, or muriate of ammonia, and having the composition NH_4Cl .

The reaction between the lime salts and ammonium chloride is a very distinctive one; taking, for instance, sulphate of lime, we get:



Both sulphate of ammonia and chloride of lime (note 1) are easily soluble in water, and a high degree of concentration would have to be reached before deposit of solid matter could take place; but, as I have already pointed out, natural waters containing lime salts, either sulphate or carbonate, nearly always contain magnesia in some form or other, and I may be pardoned for once more referring to the great danger attendant upon the use of sal ammoniac in presence of magnesia. Taking, for instance, magnesia as commonly present as bi-carbonate, a reaction between this salt and sal ammoniac would set up as follows:



Magnesium chloride is very unstable, and in presence of heat at once breaks up into oxide of magnesia and hydro-chloric acid. The acid, being volatile, passes off with the steam, and plays havoc with steam pipes and engine valves; while magnesia salt is in even worse shape than it was originally, since oxide of magnesia is a very fine substance, entirely insoluble in water, and forming a ready bonding agent. Any compound containing even a small percentage of sal ammoniac should be looked upon with suspicion, unless magnesium salts are entirely absent from feed water.

(Concluded in Next Issue.)

NOTE.—Ca Cl₂ must not be confounded with the compound usually sold as a disinfectant under the name of chloride of lime, which is a mixture of chloride and hypochlorite of lime.



BELL TELEPHONE COMPANY'S BUILDING, NOTRE DAME STREET, MONTREAL.

AUTHORS OF C. E. A. PAPERS.

BELOW will be found some particulars of the gentlemen who have prepared papers for the forthcoming convention in Montreal of the Canadian Electrical Association:

MR. JAMES MILNE,

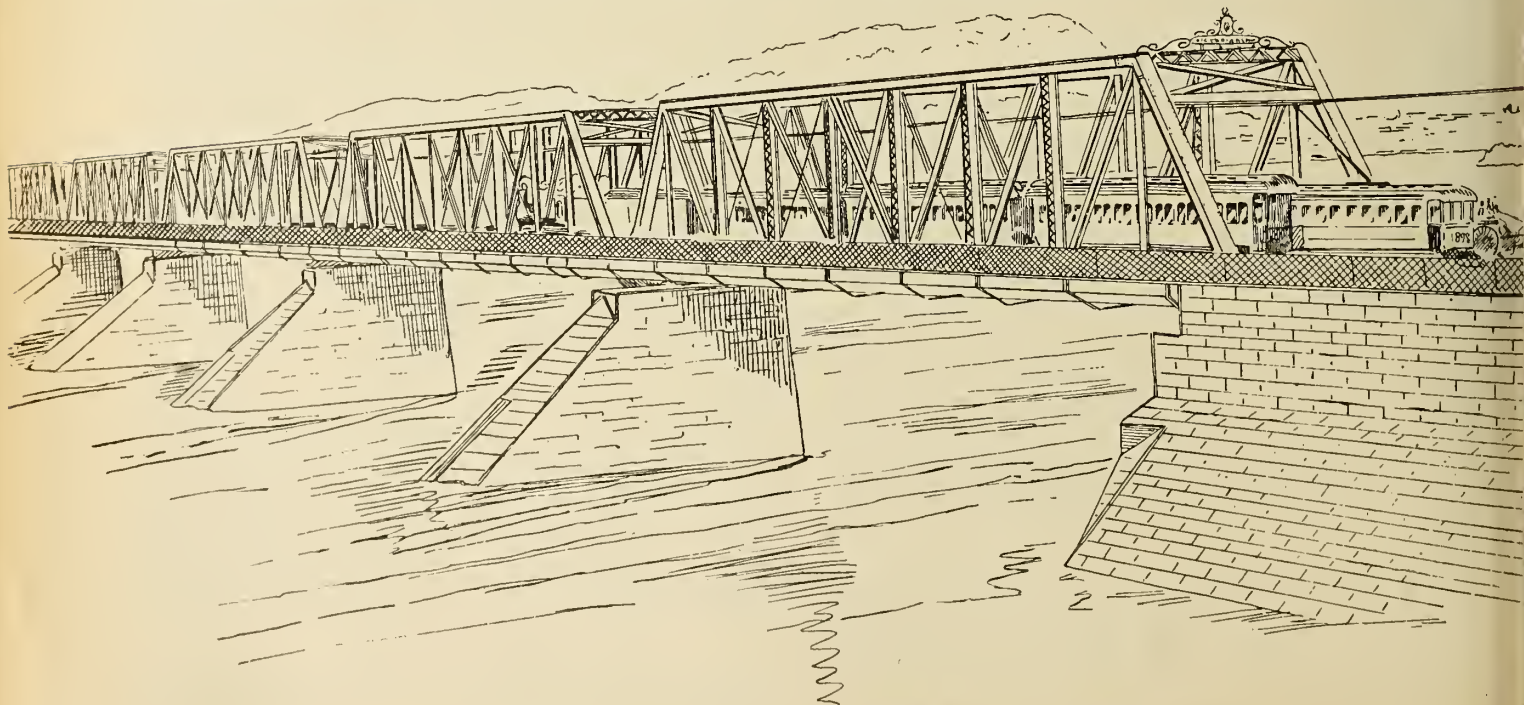
Author of the paper on "Economies in the Boiler Room," was born in Aberdeen, Scotland, in the year 1865. He served a five years' apprenticeship in engineering at Mugiemoss Paper Works, Aberdeen, Scotland, attended Gordon's college, Aberdeen, and secured from the Science and Art Department, South Kensington, London, first-class diplomas in machine construction and drawing, applied mechanics, steam and the steam engine and other branches. Twelve years ago he came to Canada and was engaged by M. D. Barr & Co. and the Edison General Electric Company, afterwards becoming a partner in the Keegans-Milne Company, electrical engineers and contractors, Montreal. Withdrawing from this firm he was appointed general superintendent of the Toronto Incandescent Light Company, and while thus engaged lectured on "Electricity" and "Steam and the Steam Engine" at the Toronto Technical School. A few months ago Mr. Milne became associated with the Weeks-Eldred Company, now the General Engineering Company of Ontario, of which he is now managing director.

MR. FRED. A. BOWMAN, M.A., B.E.

Mr. Bowman, author of the paper on "The Importance of Proper Methods of Illumination," was born at Windsor, N. S., and graduated in arts and mining engineering at King's College. He took the expert course at the Thomson-Houston Works at Lynn, Mass., and held a position with the New York office of the same company. For one year he was in the employ of the Royal Electric Company at Montreal, and since 1892 has occupied the position of superintendent of the New Glasgow Electric Light Co., of New Glasgow, N. S. Besides being associated with the Canadian Electrical Association, he is a member of the American Institute of Electrical Engineers, and president of the recently organized Maritime Electrical Association. His portrait appeared in our May issue.

MR. A. A. WRIGHT

is a Canadian by birth, having been born in the county of Leeds on the 6th of June, 1848. He received his primary education at the Farmersville High School. From there he went to the Toronto Normal, where he obtained his first-class certificate. Being anxious to acquire a thorough knowledge of the French language he proceeded to Berthier-en-Haut, in the Province of Quebec, where he devoted his time entirely to the perfecting of his knowledge of that language. Leaving Quebec in 1870 he returned to his native province of Ontario and engaged in mercantile business.



NEW VICTORIA BRIDGE, NOW IN COURSE OF CONSTRUCTION, MONTREAL.

in Renfrew, where he has remained, and is now the head of the firm of A. A. Wright & Co. In 1886 his firm first entered the field of electric lighting, purchasing two Ball arc machines, which they ran in connection with their grain elevator. Later on they added a T. H. alternating plant, and have continued in the electrical business ever since. Mr. Wright was one of the originators of the Canadian Electrical Association. He was chosen as one of its first directors, and still continues to take no small interest in the working of the society. He is an ardent politician, but has successfully withstood all attempts to allow his name to be put forward for political honors, although frequently urged to do so.

DR. J. K. JOHNSTONE.

Dr. Johnstone was born at Brantford, Ont., in October, 1849. He graduated in medicine in the year 1870, and practiced for about twelve years, when he received an appointment to the Inland Revenue Department as Inspector of Gas. Upon the adoption by the Dominion Government of an act for the inspection of electric light, he was appointed inspector for the inland revenue districts of Toronto, Guelph and Owen Sound, in addition to his former duties, with head office in Toronto.

MR. WM. T. BONNER,

who contributes two papers for the coming convention of the Canadian Electrical Association, and whose portrait appears in the group of the local committee on another page, is a native of Ohio. His early education was commenced in a private school in Chillicothe, where he remained until finishing in the high school, when he took a practical engineering course in field work under

Mr. Bonner then moved to Chicago and accepted a situation as Chicago salesmanager for Fraser & Chalmers. This position was soon enlarged to include cable railway and steam power work generally. During the summer of 1891 he engineered the deal which secured for Fraser & Chalmers the complete contract for the great Masonic temple, up to that time the largest known steam power installation for commercial buildings. Owing to his success in this connection he was afterwards given charge of many important negotiations for power installation all over the continent, including the great Broadway cable plants in New York city in 1891, requiring over 4,000 tons of boilers, engines, cable winding machinery and connections, and costing more than half a million dollars. Mr. Bonner still regards with pardonable pride the flattering comments of his principals in their letters to him while engaged on this negotiation in New York. After the close of the World's Fair he went to New York as general eastern agent for the Butman Company, of Chicago, builders of a new type of vertical boiler, continuing there, with the exception of a short engagement in Chicago late in 1894, until January, 1895, when he came to Montreal as general Canadian agent for the Babcock & Wilcox Company of New York.

Although Canada had been included as a part of the territory ceded to the English company at the time of its organization in 1880, the New York company continued to operate it up to July, 1896, when Babcock & Wilcox, Limited, assumed active charge and Mr. Bonner accepted the Cincinnati office as his choice of the United States districts offered him by the New York company. Within a few months, however, he was called to London to con-



BONAVENTURE STATION, MONTREAL.

Wm. E. Strong, an eminent civil engineer engaged in railroad construction and river improvement for the United States government. About this time he contracted the West Point fever, and through personal application at Washington, received from President Hayes promise of appointment. Some trivial incident occurred, however, which caused him to adopt a commercial course, filling two positions between 1878 and 1883 with book and stationery firms in Chillicothe and Toledo.

In 1883 Mr. Bonner married Miss Baker, of Toledo, and returned to Chillicothe to manage the grain and feed business of his father, who died early in 1884. A few months later he was elected secretary and manager of the Great Western Carbon Co., organized by a syndicate of Toledo capitalists to build and operate large works in Omaha for the manufacture of ammonia sulphate and bone charcoal for refining sugar. Although the feed mill in Chillicothe offered some opportunity for practice in mechanical engineering, it was not until the carbon works were being built that Mr. Bonner's natural tastes were given full scope, and he realized the opportunities before him. Although absolutely without experience and entirely ignorant of the character or process of manufacture of the product to be turned out, the executive and technical management of the carbon business was entrusted to him, and within a year he brought the works to a state of perfection highly satisfactory to his company—certainly a creditable achievement for a youth of twenty-four. In 1888 the business was wound up owing to failure of supply of raw material, and he then commenced business for himself as contracting mechanical engineer, making a specialty of designing and installing steam power plants. In this he was fairly successful until the repeated failure of crops in the west burst the bubble of inflated values in Omaha, Kansas City and other places in 1890.

sult with the English company regarding Canadian business, with the result that he returned to Montreal in October, 1897, as manager for the entire Dominion of Canada, which position he now holds.

Mr. Bonner is very enthusiastic about his chosen profession, and makes it an invariable rule to study the principle and plan of any important engineering work or power installation wherever he goes. During the past fifteen years he has visited every important place in Canada and the United States east of the Rocky mountains, and the information gained from personal observation of engineering methods here and also in England, Ireland, Scotland and France, places him in a very enviable position as a consulting engineer. Naturally of an inventive turn of mind and quick to devise methods for overcoming difficult engineering problems, his contracts are carried out with satisfaction alike to his company and their customers. The Babcock & Wilcox offices in Montreal also reflect his taste and ingenuity, being generally regarded by well posted authorities as unequalled for convenience and effective display.

Although a member of several social and athletic clubs, Mr. Bonner is not in any sense a club man, preferring the more profitable pleasure of technical organizations. A member of the American Society of Mechanical Engineers since 1892, Mr. Bonner, on coming to Canada, soon became interested in the Canadian Electrical Association and the Canadian Mining Institute, being re-elected in March last a member of the executive council of the Quebec division.

As early as 1876 he contributed to the local publications notes on his observations at the Centennial and other subjects. His paper on ancient Pompeian boilers read before the New York meeting of the American Society of Mechanical Engineers in 1896

was very extensively copied and commented upon by the technical and news papers all over the United States, and also by London Engineering and many other journals in nearly every foreign country.

MR. M. W. HOPKINS.

Mr. M. W. Hopkins, B.Sc., C.E., author of the paper on "The Electric Current in the Rainy River Gold Mines," was connected with the construction of the Hamilton, Grimsby and Beamsville Electric Railway. Recently he has been engaged in civil engineering in the gold fields of Northwestern Ontario.

MR. L. DEWITT MAGIE.

Mr. L. DeWitt Magie was born in Northern Pennsylvania about 32 years ago. He became connected with the Stanley Electrical Mfg. Co., of Pittsfield, Mass., at its inception in 1890, remaining with them until June, 1895, when he received the appointment of chief electrical engineer of the Royal Electric Company, Montreal, with whom he has been engaged since that time. Mr. Magie gained considerable prominence in Canadian electrical circles in connection with the electrical work on the North Shore Power Company's plant at Batiscan Chute, Que., carrying power to Three Rivers, a distance of 16 miles, and also in the reorganizing of the Montmorency Power Company's work at Montmorency Falls, Que., transmitting power to Quebec city, a distance of 10 miles. He is also chief of the Chambly Mfg. Co.'s plant, which will transmit power from Chambly Rapids to Montreal. This plant is the largest of its kind in Canada, conveying electrically 25,000 h.p. a distance of 14 miles.

THE ELECTRIC LIGHTING FRANCHISE AT OTTAWA.

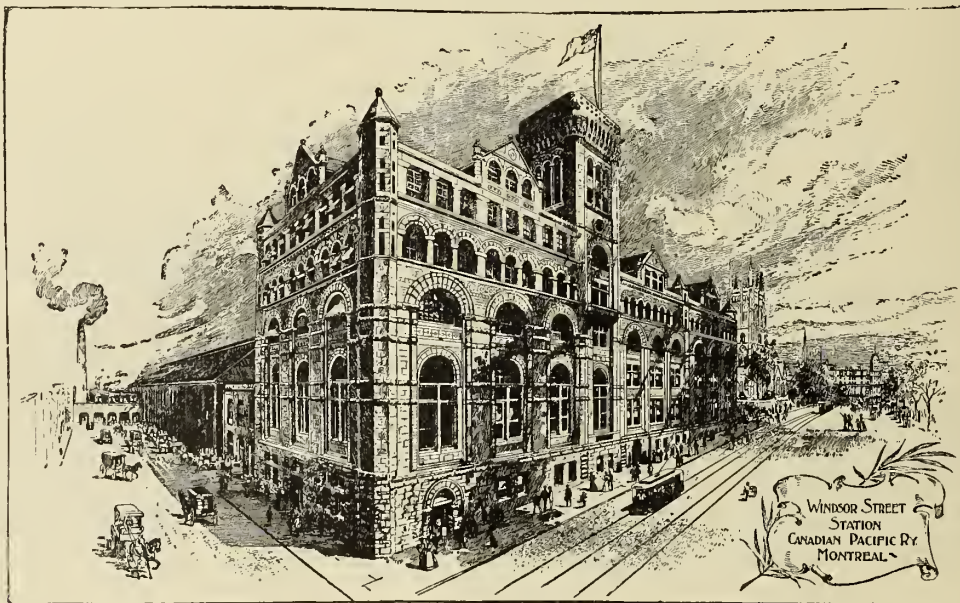
THE following review of the steps that have been taken in connection with the application of the Deschenes Electric Company for permission to supply light and power within the city of Ottawa is furnished by a correspondent:

The Ottawa Electric Company, which is a combination of the

etc.) was refused by a vote of 14 to 10. Notice of reconsideration was immediately given by one of the aldermen.

During these events a gentleman connected with the Deschenes Company made statements in the public press charging certain aldermen with getting their lights from the Ottawa Electric Company free of charge. This was immediately taken up by the Ottawa Company, who appointed the president of the Board of Trade as referee, and asked him to appoint certified accountants to go through the books of the company. This he did, and published a report completely exonerating the aldermen from the charge, and showing it to be absolutely false. In the meantime, a public meeting had been called at the city hall to consider the question of these charges, at which meeting the accuser of the aldermen was to substantiate his charges, or failing to do so was to give \$100 to the charities of Ottawa. The meeting was largely attended and proved a boomerang to those who had called it. Not only were the charges dropped in the most ignominious manner, but the meeting proved itself in favor of municipal ownership, and asked that no other company be allowed to do business in the city, and thus complicate matters for a transfer to the city.

At a later meeting of the City Council the aldermen refused to re-consider the question. A motion to rescind at the end of the meeting was also voted down. The motion adopted by the Council gave the Ottawa Company a monopoly of electric lighting in Ottawa for seven years, the unexpired portion of their contract for lighting the city streets, and the company agreed to sell out to the city by arbitration at any time the city might wish to acquire their plant and business. The legality of this was attacked on the ground that the Council could not give exclusive privileges; this was confirmed by the City Solicitor's opinion in writing. A motion was then introduced providing that the city give the Ottawa Electric Company such exclusive privileges for seven years subject to the company obtaining the necessary legislation to enable the city to make with the company a contract to that effect. This would have settled the case between the companies



three electric lighting companies formerly existing in the city of Ottawa, namely, the Chaudiere Electric Light & Power Co., the Standard Electric Co. of Ottawa, Limited, and the Ottawa Electric Light Co., have had a busy time lately fighting off opposition.

The Deschenes Electric Company, incorporated by letters patent and promoted by the principle owners of the Hull Electric Company, applied to the Dominion government and obtained permission to lay cables across the Ottawa river opposite the city, and to bury such cables on the government reserve along the banks of the Rideau canal to a point opposite the Canada Atlantic central station, from where they could distribute current to the city. The cables having been successfully laid, they were connected to the Russell Theatre, which they could light without using any of the city streets. Later on they filed an application with the City Council, asking for permission to supply light and power to the citizens of Ottawa. This application was referred to a special committee, who asked both the Ottawa Electric Company and the Deschenes Company to make proposals to the city as to what rates they were disposed to accept, etc. The Deschenes Company asked a rate of one cent per ampere hour, with cash discount of 40%, while the Ottawa Company offered a similar rate, with 33 1/3% for prompt payment. On account of the large number of customers who would get immediate benefit of the discount, and the fact that the Deschenes Company had not yet any business in the city, it was urged by the Ottawa Company that their offer was as advantageous as that of the Deschenes Company. They were later asked to make their discount 40%, which they agreed to do, and which they immediately did, announcing in the city papers that this discount would be granted from that date.

When the question came up before the City Council, the application of the Deschenes Company (which, by the way, did not offer to pay the city anything, although the company is not a local one and were paying nothing to the city in the way of taxes,

and the city, but it was side-tracked by an amendment referring the question back to the committee in order that they might ascertain from the Ottawa Company on what terms it would sell out to the city. The matter now rests there, and it would be interesting to know what the next move will be.

The Ottawa Electric Company, who spend \$100,000 per year in the city, and pay several thousand dollars in taxes, and whose employees all reside in the city of Ottawa, felt that they could not allow a company whose plant and business was all outside to come into the city, and, without paying anything for the privilege, cut rates and take a part of their business from them, without making strenuous efforts to prevent it. In this they were supported by a large portion of the citizens, who felt that the home company should be given the preference, especially when they were willing to make their rates as low as any that had been offered, and it was also the general opinion that it would be better to have only one company to deal with should the city ever wish to acquire a plant.

It is not unlikely that a plebiscite will be submitted to the electors asking if they are favorable to the city owning and operating an electric plant, not only for street lighting of the city, but also for distribution to the citizens generally.

In the Council fourteen of the aldermen are stated to have supported the contentions of the Ottawa Company. There were some among the ten who opposed it who fought bitterly against the company. One would think from their treatment of the matter that the company had been a public nuisance rather than the means of introducing electricity into almost every home in the city at a time when it was difficult to get any capitalist to invest his money in electrical enterprise. Now that the company has shown that the business can be made to pay, there are many ready and anxious to spoil their business in order to get a small slice themselves.

The Royal Electric Company is installing an arc plant for the Soulages Canal.

CANADIAN PACIFIC RAILWAY COMPANY'S LONG COPPER WIRE.

OWING to the Yukon excitement, and the greater prosperity now prevailing throughout Canada, the telegraph business between the far west and eastern Canada has so largely increased as to necessitate the erection of additional wires by the Canadian Pacific Railway Company's telegraph department. In addition to over 1,000 miles of iron wire put up on different sections this year, the management decided on stringing a copper wire weighing 300 pounds per mile from Montreal to Vancouver, to be used for Pacific coast business. Montreal to Vancouver being too great a distance for the practical working daily of a through connection by means of an iron wire, all transcontinental telegrams are at present received and transmitted at Winnipeg, two iron wires of 580 pounds per mile being used. This entails additional expense for salaries, and, of course, a certain amount of delay. Copper being about six times better as an electric conductor than iron, the new wire will bring Vancouver nearer to Montreal, electrically, than now Winnipeg is.

The circuit will be worked duplex, i.e., telegrams passing in opposite directions simultaneously. Automatic repeaters will be placed at Fort William, Ont., and Swift Current, N.W.T., thus dividing the line into three, approximately, equal sections. It is quite likely that during part of the year repeaters will only be required at Winnipeg. The copper wire will be reserved for transcontinental business, and the present two heavy iron wires will be used for business with Winnipeg and the Northwest and any overflow from the copper wire.

Should the overland business increase beyond a certain point, the copper wire will be quadruplexed, i.e., two telegrams sent each way, or four in all, at the same time. When completed this will be the longest land line circuit worked daily in the world.

The wire is being drawn by the Dominion Wire Manufacturing Co., at Lachine, from Calumet and Hecla copper. Tests are made daily from every tenth bundle at McGill college by Graham Drinkwater, under the supervision of Prof. Bovey, L.L.D., C.E. The wire is required to stand a breaking strain of 960 pounds, with an elongation of one per cent; 30 twists in a six inch length; to be wound in six close turns around wire of its own diameter, and untwisted without breaking; weigh between 295.6 and 304.3 pounds per mile; diameter between .136 and .138 of an inch; and a minimum conductivity of 96 per cent. of pure copper. Should any sample not pass the tests, each remaining bundle in the lot of 10 is tested and all not passing are rejected. The approved bundles must have an inside diameter of 24 inches, and weigh between 150 and 220 pounds without splice or brace, either in the original rod or the completed wire. Mr. Drinkwater tags each bundle and looks after the shipments. The tie wires are soft copper of the same diameter as the line wire, the manner of tying being one designed by Mr. Townsley. The joints in construction are made with what is known as the McIntyre sleeve with the ends soldered, it having been found that without the solder as made in the United States the joint broke at about 500 pounds strain. By soldering the breaking strain is increased to 900 pounds.

It was intended to use white porcelain insulators, and 120,000 were ordered from Europe; but on account of delay in shipping the work was commenced and glass insulators used on the section from Montreal to Winnipeg. They are manufactured by the Diamond Glass Co., at Montreal. From Winnipeg west, the porcelain insulators will be used, and probably the glass east of Winnipeg will be replaced with porcelain later on. The insulators will weigh 75 tons.

Although the distance, via new short line to Ottawa, is only 2,897 miles, 3,000 miles of wire is required, equal to 450 tons or 23 car-loads. To make the joints, nearly two miles of wire is used, and the necessary slack between poles takes up some six miles more. A small supply must be left with each lineman for any repairs; this will eat up about 25 miles more. The tie wires use up six and a quarter tons of copper.

Work was commenced on April 7th by one gang, and as soon as sufficient wire could be supplied other gangs were started out, until there were seven gangs, consisting of 150 men, employed. It was intended to have two more gangs on the work; but on account of considerable reconstruction of the pole line west of Winnipeg, now going forward, it was thought best not to string the copper until after this work was finished, so as to handle it as little as possible.

The section from Montreal to Winnipeg will be completed during the latter part of June, and will be put in use at once. The whole line is expected to be finished by the first of August, in time to accommodate the heavy fall business.

W. J. Camp, electrician for the department, has supervision over the whole work, which passes over three divisions. The first one from Montreal to Fort William, Ont., 990 miles, is being constructed by four gangs under Jos. Townsley, Superintendent of Construction, eastern division, assisted by J. F. Richardson, Assistant Electrician.

The second stretches from Fort William, Ont., to Donald, B. C., 1450 miles. On this section there are three gangs on the wire and two on pole work, under B. S. Jenkins, Superintendent Telegraph, western division, assisted by S. Edwards, inspector.

The last section is from Donald to Vancouver, 458 miles, J. Wilson, Superintendent Telegraph, Pacific division, assisted by E. H. Grindrod, inspector, will have two gangs on this portion. They are now on reconstruction and will start work on the copper about the middle of June.

MR. CHAS. R. HOSMER.

Mr. Hosmer, who is at the head of the Canadian Pacific Railway Co.'s telegraph system of Canada, was born of American parents in the small village of Coteau Landing, Que., (about forty miles from Montreal) in November, 1851. He started learning telegraphy at the Grand Trunk railway station at that village when a lad of thirteen, and took charge of his first telegraph office



MR. CHAS. R. HOSMER.

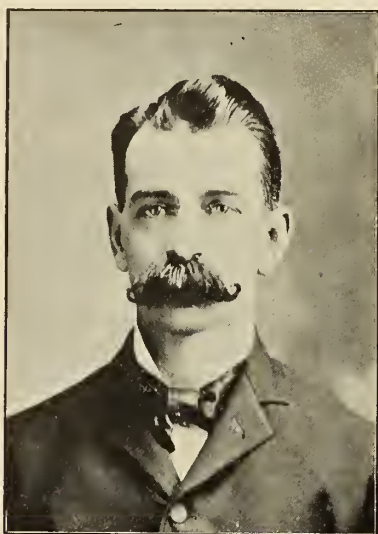
in August, 1866, since which time he has been constantly employed in the telegraph business in one capacity or another. He taught telegraphy at Beauharnois, Maskinonge and Ratiscan, in the province of Quebec, during the year 1868. From Coteau Landing he went to Kingston, Ont., in the service of the Montreal Telegraph Company, and was made manager of the Dominion Telegraph Company at that place in 1870. With the same company he worked in Buffalo in 1871, and was transferred to Montreal as superintendent of the Dominion Telegraph Company in 1873, at the age of 22. He remained in the service of the Dominion Telegraph Company until it was amalgamated with the Great North-Western Telegraph Company, when he organized the Canada Mutual Telegraph Company (in 1881), which was the Canadian connection of the Mutual

Union Telegraph Co. He was president and general manager of this company until he went into the service of the Canadian Pacific railway in 1886.

Mr. Hosmer is one of the vice-presidents of the Commercial Cable Company, and is also a director of the Postal Telegraph Company in New York, as well as of the Direct West Indies Cable Company.

MR. W. J. CAMP.

Mr. Camp, electrician of the Canadian Pacific Railway Company's telegraph department, was born April 2nd, 1855, at Oakville, Ont. He entered the service of the Dominion Telegraph Company at Prescott, Ont., in 1874, and in a few months was in charge of the wire testing in that district; the following spring he was



MR. W. J. CAMP.

transferred to Montreal as book-keeper. In 1876 he was promoted to be manager of the office at Watertown, N. Y., but a few months later left the service and worked on different points on the New York Central railroad, Troy and Boston railroad, and for the Western Union Telegraph Co., at Albany, N. Y., leaving the latter place to re-enter the service of the Dominion Telegraph Company at Montreal, where he was appointed night chief. In January, 1878, he became train despatcher for the Q. M. O. & O. R. R., but on the government seizing that road he returned to the night chiefship of the Dominion Telegraph Co., later on being advanced to assistant day chief. When the amalgamation of the telegraph companies took place he was retained by the



MR. JOSEPH TOWNSLEY.

Great North-Western Telegraph Company. In 1884 he was appointed superintendent of the Holmes Electric Burglar Alarm Company at Montreal, from which he resigned to accept his present position.

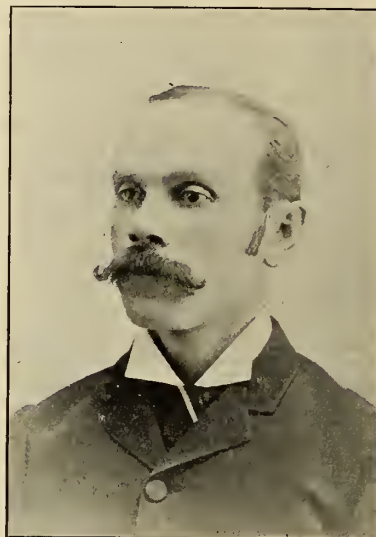
MR. JOSEPH TOWNSLEY.

Mr. Townsley was born at Rockfield, Ont., on the 24th day of January, 1842. On the 1st day of May,

1867, he entered the employ of the Montreal Telegraph Company on line repairs and construction, and only severed his connection with the old company on May 1st, 1882, to accept his present position of superintendent of construction and repairs on the eastern division of the Canadian Pacific Railway Company's telegraph.

MR. B. O. JENKINS.

Born April 8th, 1859, at Richmond Hill, County York, Ont., Mr. Jenkins entered the telegraph service at fourteen years of age at Madoc, Ont. After several

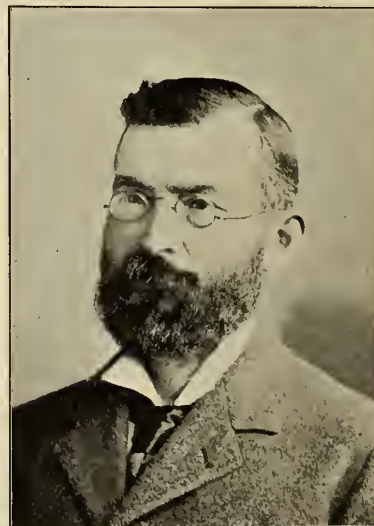


MR. B. O. JENKINS.

years service with the Montreal and Dominion telegraph companies at different points, he went to Manitoba in 1881 for the Canadian Pacific Railway Co., and was appointed superintendent of telegraphs on the western division of the system in 1883.

MR. JAMES WILSON.

Mr. Wilson was born in Elora, Ont., 1856. He first worked in the Montreal Telegraph Company's office at his native town until August, 1870. In 1872 he joined the Dominion Telegraph Company's staff in Toronto, and was transferred in 1876 to the direct United States cable station at Tor Bay, N. S. In 1876 he was inspector and paymaster of construction, and in 1879 superintendent of construction for the Dominion Telegraph Com-



MR. JAMES WILSON.

pany in the maritime provinces. In May, 1880, he was appointed district superintendent in British Columbia of the Dominion government telegraphs, which position he held until the system was purchased by the Canadian Pacific Railway Company, October 1st, 1886, when he was appointed superintendent of the Pacific division of the Canadian Pacific Railway's telegraph system.

MR. JAMES KENT.

Mr. Kent, Superintendent of the Canadian Pacific Telegraphs, Montreal, Quebec, was born in Montreal on January 15th 1854. He entered the service of the

Montreal Telegraph Company as messenger, shortly after leaving school in 1868. He was promoted to the operating room as check boy, and after a short time became an operator. After working as such for five years he was appointed night chief, and subsequently day wire chief for the same company, which position he held until 1886, when he resigned to accept the position of chief operator of the Canadian Pacific Railway Telegraphs at Montreal, which opened for business that



MR. JAMES KENT.

year. In 1890 he was promoted to the superintendency of the eastern division of the same system, which position he still holds.

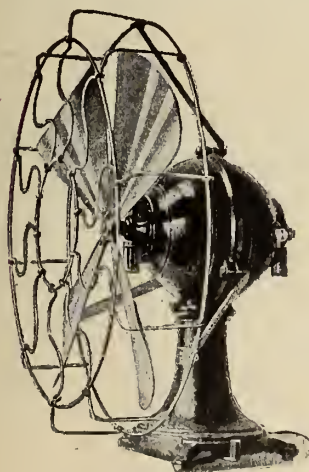
AN UP-TO-DATE SUPPLY HOUSE.

THE establishment of R. E. T. Pringle, 216 St. James street, Montreal, is now well and favorably known throughout Canada as one of the leading supply houses. Previous to 1898 Mr. Pringle had only a small office, from which he transacted a small but growing business, confining his efforts, however, almost exclusively to the sale of Packard lamps and transformers and Toronto motors and generators; but in January of last year, realizing the large field and increasing demand for all lines of electrical goods, he opened his present establishment, where, notwithstanding keen competition, he has, by sound business principles and straightforward dealing, built up what is generally conceded to be one of the most up-to-date supply houses in Canada. Intending visitors to the Electrical Association Convention should not fail to call on Mr. Pringle, who is a member of the local committee, and whose genial countenance appears on another page of this issue.

FAN MOTORS.

SOME means of maintaining a circulation of air to lessen the oppressive heat of summer have been employed by all nations for many centuries. A marked difference, however, exists between ancient and modern methods, and the development of the electric fan motor is one of the triumphs of nineteenth century civilization.

Now that the fan motor has passed through the experimental stage, and is a commercial success, both electrically and mechanically, it has become an important factor wherever the electric system is in use, in making more endurable the heat of the summer months.



C. G. E. FAN MOTOR.

For the season of 1898, the Canadian General Electric Company, Limited, present a splendid line of fans for both direct and alternating current circuits. These machines are designed with great care, special attention being paid to thoroughly tested construction. The best of material is used, and the workmanship is first-class in every particular, thus ensuring both durability and noiseless operation. They are artistic and substantial in appearance, besides embodying every valuable improvement suggested by long, practical experience. The various parts are as well proportioned as in larger machines, and no fear of excessive wear or heating need occur where the motors are operated continuously. Attention is called

in our advertising columns to the specifications of the various types of fan motors handled by the Canadian General Electric Company.

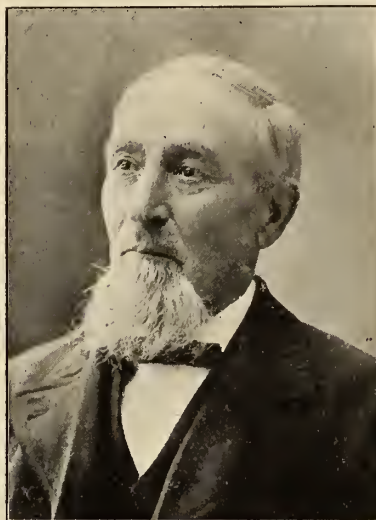
The exclusive field covered by the CANADIAN ELECTRICAL NEWS renders it a valuable advertising medium.

MR. WILLIAM SUTTON.

WE present herewith a portrait of Mr. Wm. Sutton, a charter member and past vice-president of the Canadian Association of Stationary Engineers, and president of the Wm. Sutton Compound Co., of Toronto, Limited. Mr. Sutton is the inventor of the Sutton boiler compound, Sutton steam blower and vaporizer, and the Sutton tile machine. He was born in 1834, in Lincolnshire, England, and received his engineering training at Messrs. Tuckford's Engine and Machine Works in the city of Boston, Lincolnshire. After a few years he was appointed assistant-engineer at Billingham Dales pumping station, and while thus engaged began first experiments in connection with boiler scale and its removal by vegetation. While pumping the water off the moors into the sea, a marked improvement was noticeable at different periods of the year. He continued his study along these lines until a few years ago, when he completed his task and placed upon the market the now famous Sutton boiler compound, which is said to be meeting with success wherever used.

Mr. Sutton came to Canada forty-two years ago, when a young man, and since that time has held responsible positions, being chief engineer of the Orangeville waterworks, travelling engineer for the Slate Line and Sullivan Railroad, and engineer for the Pure Gold Mfg. Co., of Toronto. It was while in the employ of the last-named company that the final tests of his study and experiments were concluded. By the advice and persuasion of his friends, and realizing the field for a first-class article for the removal of boiler scale, he decided to manufacture the compound for the benefit of steam users. Mr. Sutton claims for his invention that it contains no acids, caustic soda, or zinc, and that those who have given it a trial acknowledge it a superior compound, its use resulting in no injury to the boiler, valve seats or packing. It is therefore used extensively by breweries, bakeries, dye works, steam laundries, etc.

Owing to increased business, it was soon found desirable to form a company to undertake the manufacture and sale of the compound. This is known as the Wm. Sutton Compound Com-



MR. WILLIAM SUTTON.

pany, Limited, being composed of some of the leading manufacturers in the city, the office being at 206 Queen street east, Toronto. Since placing the compound on the market, the sales have increased so rapidly as to necessitate several additions to plant and stock. Mr. Sutton naturally feels a justifiable pride that, after years of study and experiment, carried on under rather unfavorable circumstances, satisfactory results have finally been accomplished. Upon request the company will gladly furnish a sample of the compound to steam users.

PUBLICATIONS.

E. L. Powers, of Monadnock Block, Chicago, issues quarterly the American Electrical Directory and Buyer's Manual, combining what is claimed to be a complete list of electric lighting central stations in the United States, Canada and Mexico, with details and other valuable information. It is issued in January, April, July and October, the subscription price being \$4 annually.

We have been favored by the Canadian publishers, The Copp Clark Co., Limited, of Toronto, with a copy of a Pocket Hand Book for Mechanical Engineers recently compiled by Mr. David Allan Low (Whitworth Scholar), M. I. Mech. E., Professor of Engineering East London Technical College. The book, which is well printed and bound in cloth, is 4 x 6 inches in size, and comprises 750 pages, with upwards of 1,000 illustrations. The author claims to have spared no pains to verify the correctness of the tables and calculations embodied in this book so as to make it thoroughly up-to-date. The price is not given, but may be obtained by persons interested on application to the Canadian publishers as above.

G. B. Burland, of Montreal, has installed a Kingsley water tube steam boiler plant in the Union Card and Paper Company's new works. This is the second order that Mr. Burland has given for Kingsley boilers after using them for four years. They were installed by E. A. Wallberg, of Montreal.

SPARKS.

Steps have been taken at Truro, N. S., to improve the quality of electric light wiring done in buildings.

The Toronto Railway Company have ordered from the Canadian General Electric Company twenty additional C.G.E. 1000 motors.

Charles Baillairge, C.E., of Quebec, at the request of a Belgian firm, has made a test of the water power of a river about twenty miles below Malbaie, Que.

The Jenckes Machine Co., of Sherbrooke, Que., shipped on the 5th May one of their complete 10 stamp mills to the Cariboo Mining, Milling & Smelting Co., Fairview, B.C.

The Great Northwestern Telegraph Company have completed an extension of their line into British Columbia. Offices will shortly be opened at Vancouver and other important points in the province.

Mr. R. Prefontaine, of St. Agathe des Monts, Que., has placed an order with the Canadian General Electric Co. for one of their thousand light single phase standard ironclad armature type of alternating current generators.

Messrs. Geo. M. Webster & Co., of Quebec, coal handlers, are improving their facilities for unloading steamers, and for this purpose have placed an order with the Jenckes Machine Co., of Sherbrooke, Que., for four of their double cylinder rapid coal hoisting engines, with boilers.

The Finance Committee has made a recommendation to the City Council that steps be taken to acquire the street railway system, and that the committee be authorized to obtain such information as will enable it to recommend to the council an offer for the company's property.

The Pembroke Navigation Company has placed an order with the Canadian General Electric Company for equipping their steamer Victoria with a complete electric lighting plant, which will include a six kilowatt Edison type dynamo, a vertical automatic engine, and a search lamp of 4000 candle power.

The Cornwall Electric Street Railway Company, Limited, have ordered from the Canadian General Electric Company four C.G.E. 1200 motors, to be used in the equipment of another freight locomotive which they have been obliged to put on their road to supply the increased demands on them for freight service.

The Smuggler Gold Mining Co., with headquarters at Toronto, have decided to put a 20 stamp mill on their property at Fairview, B. C., this summer, and an order for the same has been placed with the Jenckes Machine Co., of Sherbrooke, Que., for Corliss engine, 20 stamps, vanners, and four miles of Aerial tramway.

The Canadian Copper Co., of Copper Cliff, Ont., are fitting a new shaft, and have placed an order with the Jenckes Machine Co., of Sherbrooke, for two 100 h.p. special steel boilers, one 12 x 15 double cylinder double drum winding engine, three large steam pumps and rock breaker, and necessary gear for operating same.

The Toronto Electric Light Co. and G.N.W. and C.P.R. Telegraph Companies are considering the question of putting the electric wires underground on Yonge street, between Front and King streets. The city engineer estimates that a conduit containing twelve ducts, each capable of carrying 200 wires, would cost \$29,000.

The North Shore Electric Railway Co. has been granted a Dominion charter, the promoters being William Owens, of Westmount, R. Prefontaine and A. J. Coriveau, of Montreal, and others. It is intended to build a railway from Three Rivers along the north shore of the St. Lawrence river, and to use the power generated at Shawenegan Falls.

The city engineer of London, Ont., has submitted an estimate for the construction and operation of a civic electric lighting plant, showing the cost to be 25.06 cents per light for 350, as against 25 cents per light for 298 lights 2,000 candle power, as at present paid, per contract. The estimate for the proposed arc plant of 350 lights is \$80,236.50.

The Bell Asbestos Co., of Thetford Mines, Que., are changing their system of operating their mine hoist, and for this purpose have placed an order with the Jenckes Machine Co., of Sherbrooke, Que., for one of their 100 h.p. steel tubular boilers, and have also purchased from the same company one of their small locomotives, for shifting cars in pits.

In the Hull Superior Court recently judgment was rendered by Judge Lavergne in the case of the Bytown and Aylmer Turnpike Company against the Hull Electric Company. The judgment recited that defendant against the will of the plaintiff forcibly took possession of certain portions of the Aylmer road and built an electric railway along and across the highway. The judge ordered defendants to forthwith remove all its tracks, poles, wires and other apparatus from the portions of the road, and in default 15 days from the service on the defendant of the present judgment plaintiff is authorized to do so at the expense and risk of the defendant, and the defendant is enjoined to refrain for the future from using the highway, and is condemned to pay plaintiff \$1,056 with costs.

The Recorder at Montreal has given judgment against the Montreal Street Railway Company for the nominal sum of \$25 and costs for refusing to build and operate their line up Cote des Neiges Hill, as agreed by them in their contract with the city, within a certain space of time that expired on the 1st of May, 1897. The company argued that the road would be too dangerous, but the city obtained evidence from experts to prove that the new street car line in Quebec is built with much shorter curves, much steeper hills, and much shorter declines and inclines than would mark the line

in question. The Recorder said: The preponderance of testimony shows that if there is to be any danger attached to the line, that danger can only be caused by negligence, ignorance or imprudence on the part of the company, its engineers or other employees, and to this all institutions of a similar nature are liable. He regretted exceedingly to be compelled to find the company guilty, because, as a rule, it had fulfilled its duties towards the city well; but it had neglected its agreement with the city in this instance, and without being able to prove that there was really anything to prevent its carrying out its obligations.

As the first step towards the inauguration of a system of radial railways for Toronto, a committee of the Board of Works had a conference recently with the management of the Metropolitan street railway. It was suggested that the Toronto Street Railway Company give running powers over the Church street route, which could be used as a trunk line for all the radial roads. One difficulty in the way, however, is that the statute provides that the standard width of all radial railways shall be 4 feet 8 3/4 inches, while the Metropolitan and Toronto railway tracks are 4 feet 10 1/4 inches apart. The committee decided to have an interview with the manager of the Toronto street railway and endeavor to formulate a plan which would be acceptable both to the street railway and suburban companies.

MOONLIGHT SCHEDULE FOR JULY.

Day of Month.	Light.	Extinguish.	No. of Hours.
	H.M.	H.M.	H.M.
1....	No Light.	No Light.	.....
2....	No Light.	No Light.	.....
3....	No Light.	No Light.	.....
4....	No Light.	No Light.	.....
5....	P.M. 8.00	P.M. 10.30	2.30
6....	" 8.00	" 10.30	2.30
7....	" 8.00	" 11.00	3.00
8....	" 8.00	" 11.30	3.30
9....	" 8.00	A.M. 12.10	4.10
10....	" 8.00	" 12.40	4.40
11....	" 8.00	" 1.00	5.00
12....	" 8.00	" 1.20	5.20
13....	" 8.00	" 2.00	6.00
14....	" 8.00	" 2.40	6.40
15....	" 8.00	" 3.40	7.40
16....	" 8.00	" 3.40	7.40
17....	" 8.00	" 3.40	7.40
18....	" 8.00	" 3.40	7.40
19....	" 8.00	" 3.40	7.40
20....	" 8.00	" 3.40	7.40
21....	" 8.00	" 3.40	7.40
22....	" 8.00	" 3.50	7.50
23....	" 8.00	" 3.50	7.50
24....	" 8.50	" 3.50	7.00
25....	" 9.30	" 4.00	6.30
26....	" 9.50	" 4.00	6.10
27....	" 10.40	" 4.00	5.20
28....	" 11.00	" 4.00	5.00
29....	" 11.30	" 4.00	4.30
30....	.....	.....	.....
31....	A.M. 12.40	" 4.00	3.20

Total..... 150.30

IMPROVED STORAGE BATTERY EQUIPMENT.

UNDER the supervision of Mr. A. B. Smith, superintendent of construction, the Great Northwestern Telegraph Company have just made an important change in their battery system at the London office, by the installation of a very complete storage battery equipment, consisting of 260 chloride accumulators, which displace 600 cells of the common form of gravity battery, which has been the standard form of battery for telegraphing purposes for so many years past. In the matter of efficiency the storage battery has proven so much superior to the gravity that the company have decided to install these batteries at other important terminal offices. The battery is in duplicate, two sets of which are in service for 24 hours, while the other two sets are being charged or at rest. The period of charge is generally three hours for both the main and local batteries, and the current is supplied from the Electric Company's power circuit, to which the main batteries are connected direct, at the rate of 1 1/2 amperes per hour, but for the cells which supply the "local" instruments it was necessary to reduce the charging pressure from 260 volts to 2 1/2, which is done by means of a motor-generator, at a charging rate on the generator side of 15 amperes per hour. For wire service there are four battery "leads," paired negative and positive, to the switchboard, from which the current is taken at a pressure of 130 and 70 volts from each pair. To prevent an over-discharge to line in case of accident, each of the 115 battery discs on the switchboard is connected in series with the battery "lead" through an ordinary incandescent lamp, the voltage of which is 125, or 75 volts, as the "lead" may require. Should any wires become "crossed," or "grounded," the lamps on the wires affected will glow, thus acting as an indicator as well as preventing more than a safe amount of current from passing into the interrupted wires. The resistance of the magnet spools of the "local" sounders was increased from 2 ohms to 10 ohms each to prevent a short circuiting of the local cells.

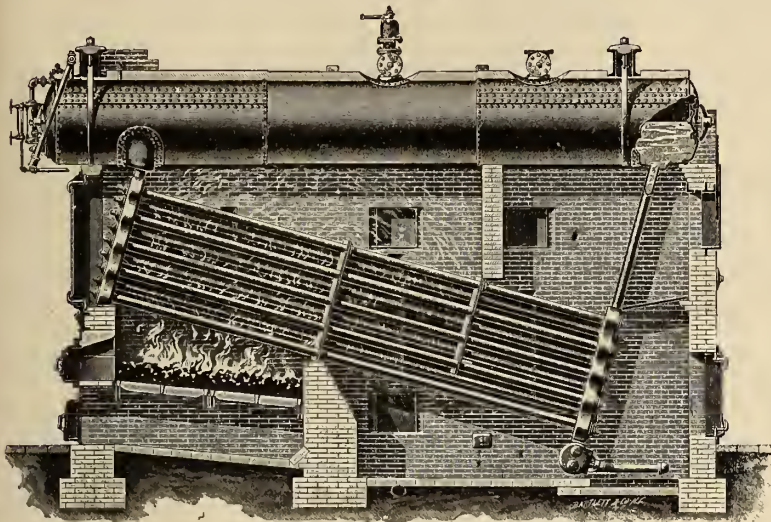
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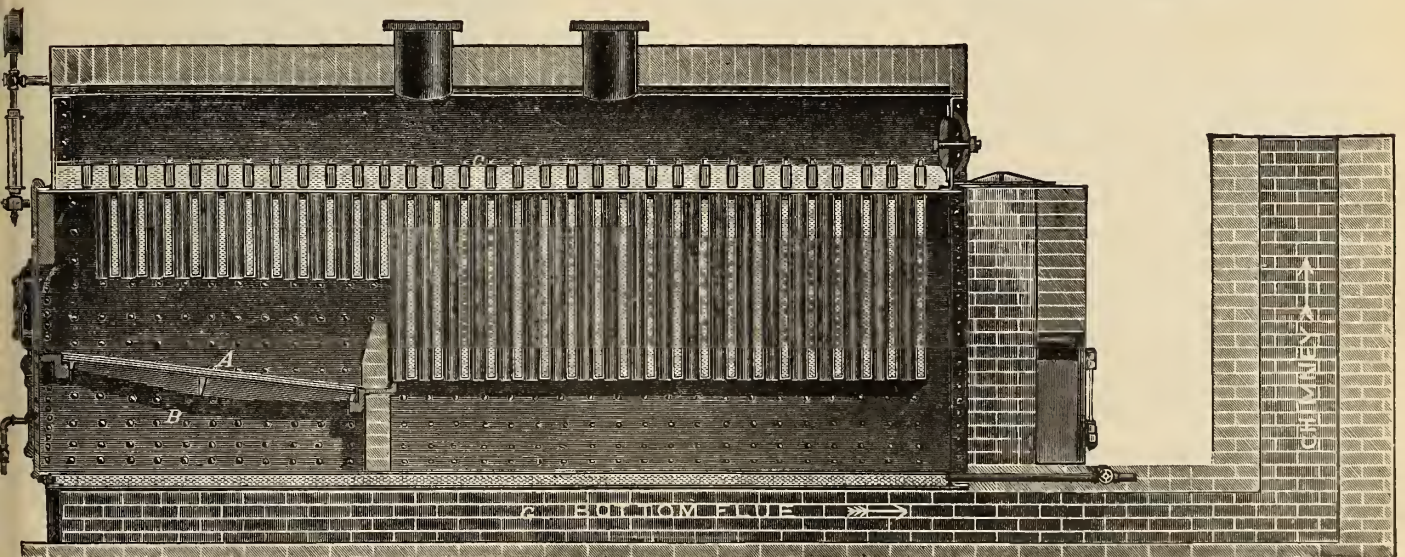
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ONTARIO ASSOCIATION STATIONARY ENGINEERS.

The yearly meeting of the Ontario Association of Stationary Engineers was held in the Oddfellows Hall, Oshawa, on May 30th. The meeting was very well attended, having representatives from London, Brantford, Hamilton, Toronto, Oshawa, Bowmanville, Cornwall, Ottawa, Uxbridge and Belleville. Three members of the board were unavoidably absent. The one change on the personnel of the board was the substitution of Mr. Rodger Fishleigh, of Bowmanville, for Mr. Wilford Phillips, of Niagara Falls.

The Registrar's report showed that there were 756 names on the membership roll, some 108 of which are yet to be renewed for this year. The Legislative Committee submitted a report upon the work done during the year, the result of which was to get a decision from the Minister of Justice that the Dominion Parliament has no jurisdiction in the case of the Engineers' Bill, and that it is entirely under the different provincial legislatures, the same as a lawyer, doctor, or land surveyor.

The financial statement of the Registrar and the Treasurer was presented and adopted. It was also arranged to apply to the Ontario legislature for amendments to the present law.

A long and useful discussion upon bringing up the engineers generally to a higher standard of efficiency, and raising the qualifications for each grade, brought out the fact that Association certificates are looked upon as accredited marks of worthiness in every province in the Dominion. Hamilton was chosen as the next place of meeting.

The personnel of the board is now as follows: President, O. P. St. John, Toronto; vice-president, A. E. Edkins, Toronto; registrar, John Bain, 113 Yorkville ave., Toronto; treasurer, Robt. Mackie, Hamilton; Arthur Ames, Brantford; F. G. Mitchell, London; Thos. Elliott, Hamilton; Thos. Wensley, Ottawa; Jas. Devlin, Montreal; T. G. Donaldson, Ottawa; A. M. Wickens, Toronto; Rodger Fishleigh, Bowmanville.

TRADE NOTES.

The Ottawa Porcelain and Carbon Works have just filled an order for 50,000 electric light carbons for the Winnipeg Electric Light Company.

The McEachren Heating & Ventilating Co., of Galt, Ont., has placed an order with the Jenckes Machine Co., of Sherbrooke, Que., for one of their patent Duke engines.

The Alberta Railway & Coal Co., of Lethbridge, N.W.T., has ordered two more Mumford improved boilers of 150 h.p. each from the Robb Engineering Co., Amherst, N.S.

The Great Northwestern Telegraph Co. is installing a new heating system in their large building in Montreal, using the Kingsley water tube boiler installed by E. A. Wallberg.

Catalogue "B" has just been issued by Mr. John Forman, electrical goods, Craig street, Montreal. It contains much information regarding the many lines of supplies carried in stock.

Mr. E. A. Wallberg, Montreal, has recently installed boilers in the Russell Theatre, the Sun Life Insurance building, the Hotel Cecil, the Harmony Hall, and Grand Opera House, in that city.

The Western Loan & Trust Co., Montreal, are installing a new heating system in their building, using the Kingsley water tube boiler installed by Mr. E. A. Wallberg, of that city. David Ogilvy is the architect.

Messrs. Sadler & Haworth, of Montreal and Toronto, have just furnished the Niagara Falls Electric Power Co. with two double belts, 44" wide, for their new generators; the Montreal Belt Line Railway, Montreal, with one 36" double belt; and the St. Thomas Street Railway with two 15" double belts.

The Dominion Coal Co. are improving their facilities for unloading from their steamers at Levis, and have purchased for this purpose four $8\frac{1}{4} \times 10$ double cylinder special coal hoisting engines from the Jenckes Machine Co., of Sherbrooke, Que., with a powerful 100 h.p. locomotive boiler to supply steam for the same.

In our last month's issue we illustrated a new switchboard recently installed in McGill University, Montreal. Messrs. Munderloh & Co. have written to us asking us to call the attention of our readers to the fact that this board was supplied and installed by them. They are also supplying and installing the electrical equipment in the new Mining and Chemistry building, which will be completed by the fall.

The Canadian Chemical Compound Company report that their special boiler compounds are meeting with a large sale, and they are well satisfied with the business secured. A sample of the orders received is shown by a letter from the Town Clerk, Mitchell, Ont., which reads as follows: "By to-day's mail I send you sample of scale taken from boiler. Please examine same and send barrel of your best material for removing same." The company are about to open a branch office in Montreal.

The General Engineering Company of Ontario have requested us to inform prospective purchasers of mechanical stokers that the American Stoker, sought to be introduced into Canada by the American Stoker Co., is an infringement on the Canadian patents owned by their company. They state that as soon as an American stoker is installed in Canada, their solicitors have instructions to take proceedings in the Exchequer Court of Canada against the user as well as against the manufacturer and importer, and they desire to give a warning in order that no underfed mechanical stoker may be installed by any person without full knowledge of their rights under their Canadian patents.

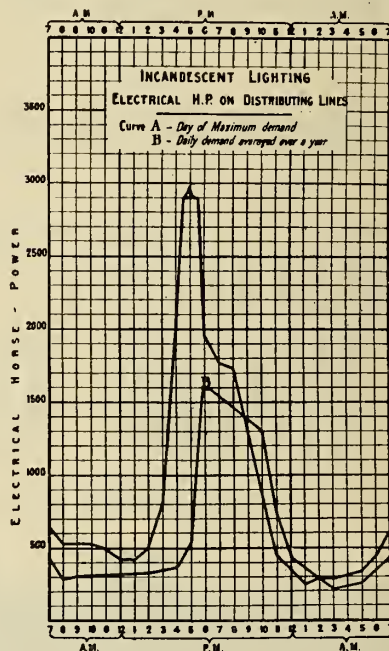
Intending purchasers of electrical apparatus, when writing to advertisers, are asked to mention the ELECTRICAL NEWS.

ELECTRICAL POWER TRANSMISSIONS.*

By R. A. Ross, E.E., M.Can.Soc.C.E.

THE subject of electric power transmissions over long distances has for the last few years been the field in which the most prominent electrical engineers have found a scope for their energies, and the advance in consequence has been most marked. So much so that, while four years ago there was not a power scheme of any magnitude, at the present they are numbered by the score, and are of such size as to utilize an immense amount of power formerly unavailable. A noteworthy point in modern plants is the similarity of the methods in use, especially in America, which is always more given to standardization than are European countries. The several types of alternating transmission have practically crystallized into two standard forms remarkably alike in detail and equally applicable to most cases. The controversies over the relative merits of direct and alternating current for transmission purposes have been settled, and the latter having come out victorious, is now carrying the war into the hitherto undisputed territory of the former, namely, the application to general motor purposes, and the results are not doubtful. With the application of alternating current motors to traction purposes, which appears to be not far distant, the last territory held exclusively by the direct current will have been invaded. The reason for this state of things is not far to seek, as the alternating system which formerly was applicable only to incandescent light, has recently made such strides as to prove itself more generally useful for all purposes of transmission and for most cases of distribution than the other. This triumph of the alternating is due to the fact that with extremely simple and durable apparatus, the power is so readily transformed into that form which meets the requirements of most cases.

The efficiency and durability of the newer types of apparatus are such as to leave but scant room for improvement, and it appears probable that unless some fundamental discovery is made which will render present types entirely obsolete, these forms will persist for some time to come. Accompanying this standardization of apparatus has come a remarkable decrease in first cost and maintenance charges, affecting the interest and depreciation accounts correspondingly, and resulting in decreased cost of power to the consumer. In consequence we may expect to see the field of steam generation for many purposes invaded by the simpler, cheaper and more cleanly electric power. If we may judge by present indications, the next phase of the problem to be attacked will be the



adaptation for railway purposes of power from large water falls. This only awaits the development of a satisfactory motor for alternating traction purposes, and, from the reports of several recent installations in Europe and the statements of prominent traction engineers in this country, the day of the alternating railway motor for use on the longer railways is not far distant.

To illustrate the methods adopted in transmission work, a few of the larger plants in operation or building are given below:

	System.	Distance.	Voltage.	Horse Power.
Brescia,	Direct current	12	15,000	700
Pomona,	Single phase	29	10,000	800
Fresno,	Three phase	35	11,000	1,400
Lauffen,	"	100	30,000	300 Experimental
Portland,	"	12	6,000	5,000
Ogden,	"	38	16,000	3,000
Three Rivers, Que.,	Two phase	17	12,000	600
Kootenay, B. C.,	Three phase	..	20,000	2,000 Building
Hamilton, Ont.,	Two phase	38	20,000	3,000 "
Lachine, Que.,	Three phase	5	4,400	20,000
Chambly, Que.,	Two phase	16	12,500	20,000 Building.

With one exception these are all alternating plants, and it will be noticed that Canada is well to the fore, as might be expected from the almost unlimited powers available. Montreal stands at the head of the world so far as transmitted power is concerned, and it appears probable that the two magnificent schemes at present under construction will find an ample market in the city and vicinity. Montreal's demands, covering as they do the whole field of consumption of power for street railway, incandescent and arc lighting, and motor power, offer a good example for illustrative purposes, and it has been deemed advisable to

* Paper read before the Canadian Society of Civil Engineers, March 10th, 1898.

give point to the discussion to follow by reference to the demands existing here at the present time, without reference to future necessities, as these will no doubt be much of the same kind.

With this end in view, the accompanying curves have been drawn, showing the demands for all classes of power at the present time for twenty-four hours.

The higher curve in each case shows the maximum demand during the year, and the lower the average load at each hour of the day for the year. From these demands the transmission scheme will be figured, but necessarily in a general way for illustrative purposes. The problem consists in laying down the power in the city to suit the demands in the most complete way as regards economy, efficiency and suitability. As these demands affect the transmission by their nature, as well as by their amount, they must be considered briefly before taking up the transmission proper.

Incandescent Lighting.—The demand curves shown have been figured from the actual curves of one of the present stations in the city, with an allowance for the loads of the other operating companies; in all to cover 100,000 lights wired up. To meet this demand it will be readily granted that direct current is unsuitable, owing to the distances to be covered, and alternating currents of single, two or three phase are the only alternative, any of these being readily obtained from the transmission voltage by means of static transformers to feed the distribution at a voltage of say 2,000, which is considered safe for city work. This potential will of course be again reduced before entering customers' premises, thus involving two sets of transformers. This system will also cover interior lighting by alternating arc lamps, and perhaps a few small alternating motors.

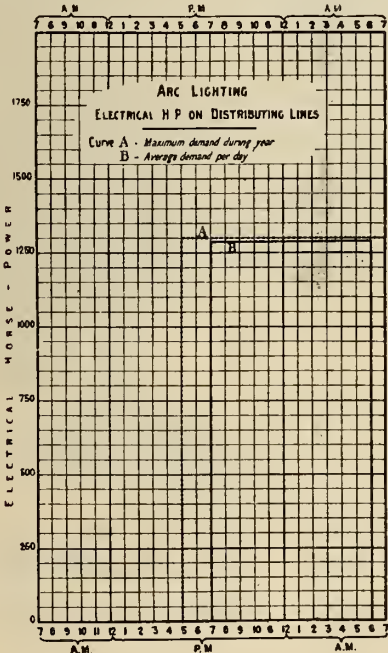
ARC LIGHTING.

The demand curves for the arc lighting have been figured on the supposition that there are 2,000 arc lamps on series circuits in the city, lighted from dusk to dawn, the curves in this case being elevated into straight lines. For this service several plans present themselves as below.

(1) By rectifying the alternating transmission currents into direct through the agency of rectifiers, which are simply revolving commutators driven by small synchronous motors from the transmission line, and using this current in the present series arc lamp. This system has been in use for a short time in several European cities, with varying results. It appears to have a great future before it when it has come through the present doubtful stage.

(2) By means of alternating arc lamps fed from the incandescent circuits. This system, while perfectly applicable for interior lighting, where each unit is treated as an incandescent lamp, and turned on or off at will, is not so suitable for street lighting, as it does not lend itself to ready control from the station. Further, as the light distribution of alternating current lamps is inferior per watt of consumption to that of direct, it becomes more expensive in operation.

(3) The series arc system as at present used, with motors instead of engines to drive the dynamos, while necessitating more apparatus than either of the others, is more simple and controllable in operation, and will be accepted for illustration. The number of units necessary to cover the 2,000 lights will be 16 if of 125 lights each, which is about as



high as is available per machine. If these were coupled in pairs to 200 h.p. motors, the units would be eight, and the addition of a spare would make a total of nine, which would be ample for present demands.

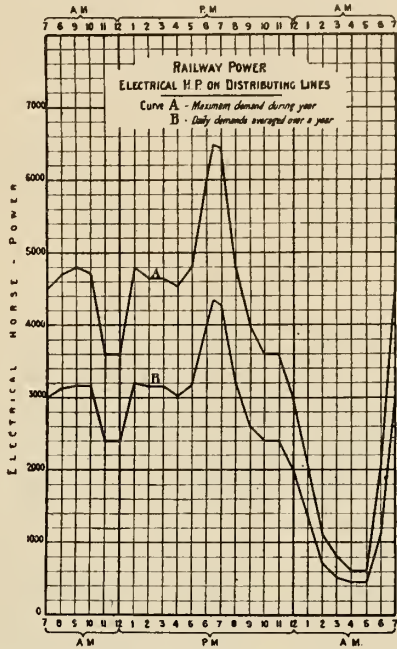
MOTOR POWER.

Either alternating or direct current motors are suitable for general work, but, where variable speeds are necessary, as for elevator purposes, the direct is at the present time the only one available. The cost of the former is also higher at the present time. The advantages of the alternating motor distribution are, less cost of circuits, greater simplicity of apparatus, and the ability to reach outlying demands at small cost, and that it involves no special apparatus in the distributing station other than the necessary lowering transformers. As the objections to the alternating (on the score of price and unsuitability where speed regulation is required) appear to be within reach of correction in the near future, that method will be adopted for this case. The demand curves are based upon the actual load curves of one of the present stations, with allowance for the other operating companies' loads. In all it represents

about 1,100 h.p. of motors installed, to be driven from a two or three phase motor circuit, fed directly through reducing transformers from the transmission line, at a voltage of say 2,000, and again reduced by individual transformers at the motors.

RAILWAY POWER.

These curves are shown in the figure below, and are the actual records for the past year for the railway company's plant. As at the present time only direct current motors are applicable to this purpose, means must be adopted for transforming the alternating to direct current for the trolley circuit. This is easily accomplished by means of rotary transformers, with small loss. These rotaries are practically direct current



generators, with collector rings, through which the alternating current flows to the windings driving the machine as a motor, while from the commutator connected to the same windings the direct current, which has been commutated from the alternating, flows to the trolley line.

TOTAL DEMANDS.

The load for all classes of demand is given to the last curve, which is formed from the others, and shows the period of the greatest station activity to be about 6 p. m.

It is evident that apparatus must be installed to meet this maximum demand, while the average output could be met by a much smaller plant.

The interest and depreciation charges on plant, which forms such a considerable percentage of the cost of the output, is a constant no matter what that output may be, so that, when it is possible to fill up the hollows in the curve by the sale of additional power during periods of light load, which shall not be operative during the period of heavy demand, the cost of this addition is only that of additional coal in steam stations, and in waters powers is nothing, and for this reason may be disposed of at low rates.

(To be Continued.)

SPARKS.

A charter has been granted to the Canadian Electric and Water Power Co., of Perth, Ont.

The Canadian Brewing Company, Montreal, is installing a new steam plant, using the Kingsley water tube boilers, ordered from E. A. Wallberg, Montreal.

On Wednesday, July 6th, the ratepayers of Listowel, Ont., will vote on a by-law to provide \$2,200 for the acquisition of a street arc lighting plant. W. E. Binning is town clerk.

The Niagara Falls, Ont., Electric Light Company are preparing to branch out into new fields, having purchased machinery to supply electricity for heating and power purposes. Improvements will be made to the power house and line.

The Tobique Mfg. Co., which proposes to obtain power by damming the Tobique river at Oxford, N. B., has been granted incorporation by the Dominion government. The company comprises Hon. John Costigan, Fred A. Hale, M.P., and Senator George T. Baird.

The Laurie Engine Co., Montreal, has recently installed in its works a high pressure compound Corliss engine and a Kingsley water tube boiler designed for 175 lbs. working pressure. This is considered in every way a model and a highly economical plant, and is said to produce power at a considerably less price than quoted by the electrical power companies. The boilers were installed by E. A. Wallberg.

The City Council of Brantford, Ont., recently invited tenders for lighting the streets of the city for a term of years, and also for furnishing an electric plant to be operated under municipal control. After opening the tenders the Fire and Light Committee decided to recommend the abandonment of the municipal idea, and the acceptance of the offer of the Brantford Electric and Operating Company. This offer is to furnish one hundred and twenty-one arc lights and 132 incandescent, of 32 candle power, at the price of \$7,300 per annum. The electric company are also to take over the present municipal incandescent system for \$600, paying in six annual instalments.

TRADE NOTES.

The Condensed Milk & Canning Co., of Truro, N. S., have ordered a 50 horse power engine from the Robb Engineering Co., to replace the one destroyed in their recent fire.

The Hamilton Electric Light and Power Company, Limited, have ordered from the Canadian General Electric Company a 200 kilowatt, 250-volt multipolar generator for their power circuit.

N. P. Tanguay, of Weedon, Que., has placed an order with the Jenckes Machine Co., Sherbrooke, Que., for one of their patent Crocker turbines, complete with gate, draft, tub and gearing.

Mr. M. McLaughlin, Buctouche, N. B., is building a large flour mill and wood-working factory, the boiler and engine for which are to be supplied by the Robb Engineering Co., of Amherst, N.S.

The owners of the Monte Cristo mine continue sinking in their main pit, and have lately added a No. 6 Cameron vertical pump, purchased through the Rossland branch from the Jenckes Machine Co., of Sherbrooke, Que.

The Wm. Cane & Sons Mfg. Co., Limited, of Newmarket, have ordered from the Canadian General Electric Company a lighting plant for their factory premises, consisting of a 17½ kilowatt multipolar dynamo and marble switchboard.

The London & British Columbia Gold Fields, Limited, of Rossland, B.C., are developing their property, and recently added to their equipment a 6x8 special hoisting engine and 40 h.p. locomotive type boiler, from the Jenckes Machine Co., of Sherbrooke, Que.

The daily note books and blotters sent out monthly by the Packard Electric Company, of St. Catharines, serve to remind the trade that they have constantly on hand a complete assortment of

electric light supplies. Their "L" transformers are rapidly growing in favor.

The Jenckes Machine Co., of Sherbrooke, Que., recently supplied the Sydney mine at North Sydney, Cape Breton, with one of their special coal hoisting engines, to be operated by compressed air. The compressor was supplied by the Canadian Rand Drill Co., of Sherbrooke, Que.

Mr. John Forman, of Montréal, has recently been appointed Canadian agent for the Upton enclosed arc lamp. This lamp is adapted for either outdoor or inside service and for operation on alternating or direct current circuits, and is said to be giving excellent service wherever used.



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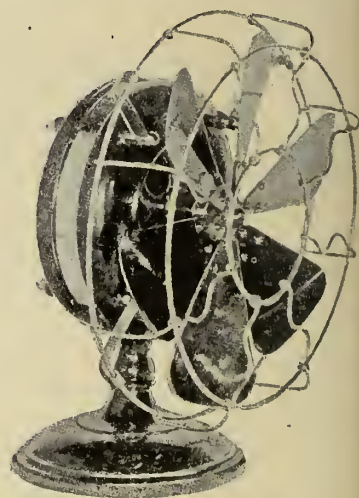
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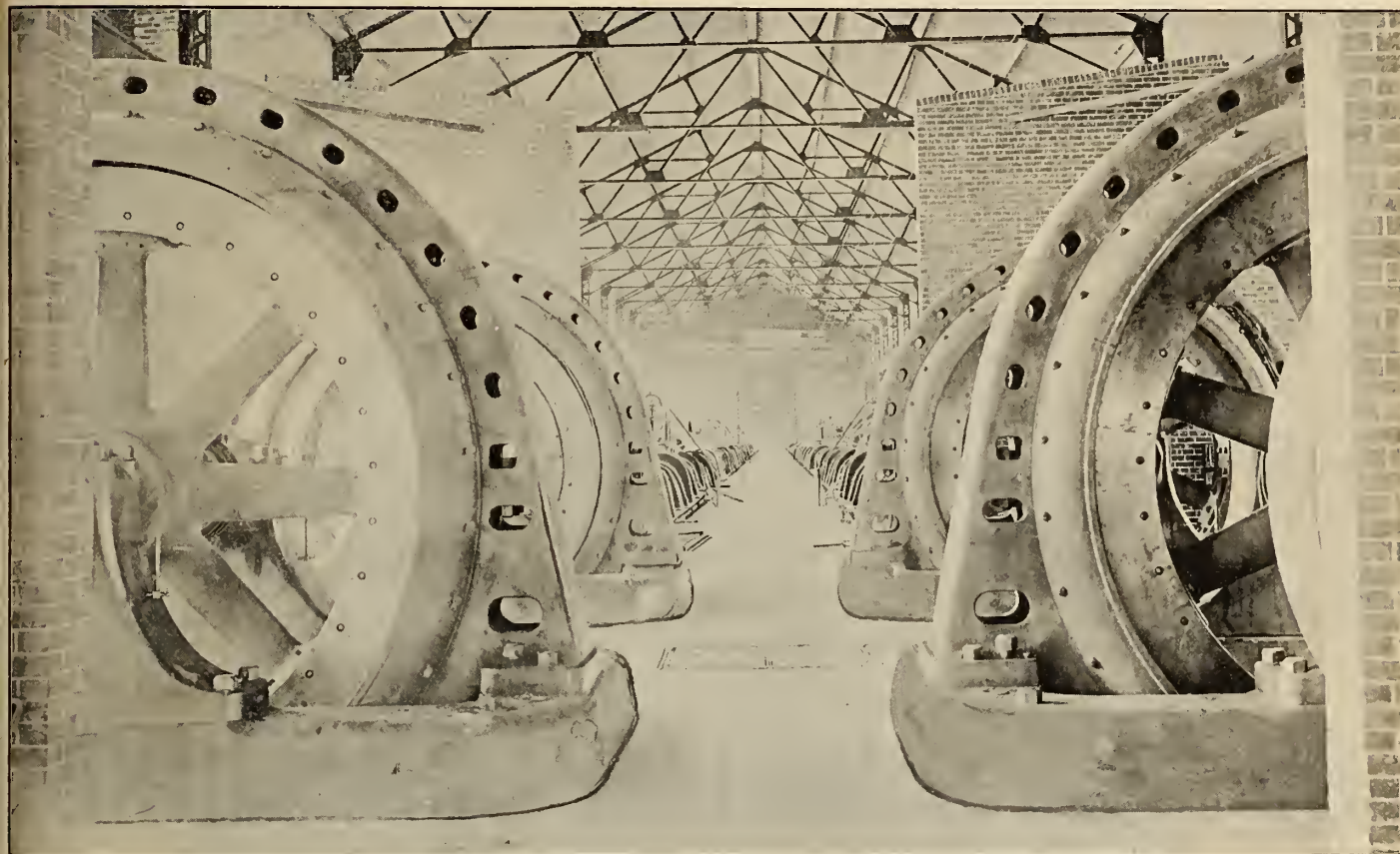
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OF ALL KINDS

Railway Apparatus

Direct Current Lighting Generators

Alternating Current Lighting Generators

Power Transmission Plants

PERSONAL.

Mr. Norman C. Smith, of the W. A. Johnson Electric Company, Toronto, has just recovered from a serious illness, which necessitated a surgical operation.

Mr. E. I. Sifton has been appointed manager of the Electrical Construction Co. of London, Ont., in place of Mr. S. R. Break, who has gone to reside in Arizona.

Mr. J. A. Kammerer, manager of the Toronto branch of the Royal Electric Company, has just returned from a trip to Winnipeg and other western points.

Mr. Frederic Nicholas, general manager of the Canadian General Electric Co., accompanied by his daughter, is at present on a visit to Great Britain and the continent.

Mr. D. A. Carr, manager of the Cornwall Electric Street Railway, was presented by his employees with a gold-headed cane, on the occasion of his birthday.

Mr. Charles Nicholson Peake, electrical engineer, of Toronto, was recently married in St. Paul's church, Wingham, to Miss Davis, daughter of Mr. Henry Davis, collector H.M. customs.

Mr. T. Ahearn and family, of Ottawa, returned a fortnight ago from a trip around the world, after an absence of six months. They came from Yokohama to Vancouver in the steamer Empress of India.

Mr. D. W. Robb, of the Robb Engineering Co., Amherst, N.S., and Mrs. Robb, have gone to London, Eng., and the Isle of Man. Mr. Robb will superintend the erection of some Robb-Armstrong engines shipped to the old country.

The many friends of Mr. S. G. Lawson, formerly on the staff of the Canadian General Electric Co., will regret to learn of his death at Barcelona, Spain, while superintending the construction of 150 car electric roads in that city and Madrid for Messrs. Dick, Kerr & Co., of London, Eng.

Mr. C. A. Barton, for three years past chief engineer at the General Electric Company's works at Peterborough, Ont., has accepted a position with the Walker Manufacturing Co. of Cleveland, Ohio. Mr. Barton will have charge of the alternating work and the designing of alternating machinery for the above company.

Mr. C. A. E. Carr, who has been manager of the London Street Railway for the past three years, has received the appointment of manager of the Montreal Park and Island Railway at Montreal, the duties of which he will perform in addition to those at London. Although a young man, Mr. Carr has shown great ability in street railway management, and his continued advancement is well deserved.

Mr. Edward Bourne, chief engineer of the Toronto Electric Light Company, was recently the victim of a bicycle accident which it was at first thought would result fatally. While wheeling east along College street he collided with a bicyclist going the opposite direction, with the result that Mr. Bourne was thrown violently on the pavement, sustaining a fracture of the base of the skull and other injuries. We are pleased to learn that he is now on the road to recovery.

Mr. J. Alex. Culverwell, of Toronto, has relinquished the local management for Toronto and Central Ontario of the Royal-Victoria Life Insurance Co., of Montreal, to undertake the business of an electrical and mechanical financial broker, he still retaining a special agency with above company. He had several years' successful connection with the old Edison General Electric Co., having exploited their business for them in Western Ontario and Quebec province. Of late Mr. Culverwell has interested himself, along with Mr. White-Fraser, C.E., the well-known electrical engineer, in the promotion of the Fenelon Falls-Lindsay Transmission Company, having secured the town lighting contract for Lindsay for ten years and private contracts amounting already to about \$17,000, yearly renewal, and also having interested some of Toronto's leading capitalists in the enterprise. Mr. Culverwell is a young man, and as a promoter is most energetic and untiring in his efforts, and has established for himself an honorable reputation. He was educated at Upper Canada College, Toronto.

The town of Brampton, Ont., invites tenders up to July 1st, for lighting the streets either by gas or electricity. Mr. T. J. Blain is town clerk.

The Marsh Stethophone, invented by Rev. D. B. Marsh, of Black Heath, Ont., is now patented in Canada, United States, France and Great Britain, the latter patents having been secured last month.

It is now thought that the proposed electric plant at Ragged Rapids, for the purpose of supplying light and power to the town of Orillia, Ont., can be installed for \$75,000. This is the sum which the ratepayers will be asked to grant for carrying out the work.

The Montreal Street Railway Co. will make considerable extensions to their lines during the present year. It is proposed to lay a double track along St. James street, from McGill street to the city limits, and to commence the Verdun extension of one and one-half miles at an early date. The company have erected a new blacksmith shop, 75 x 58 feet, at Hochelaga, to be used for repair work.

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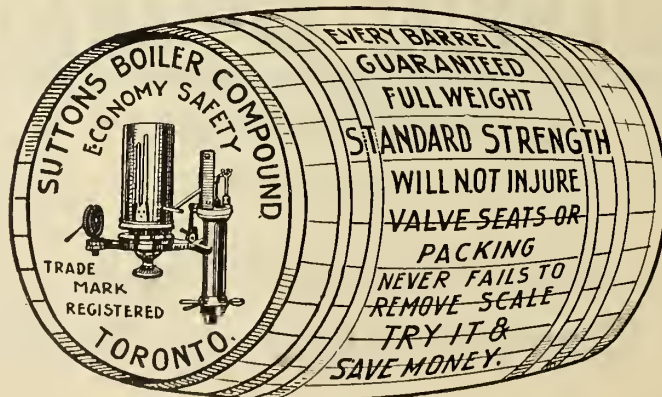
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PHASE

GENERATORS

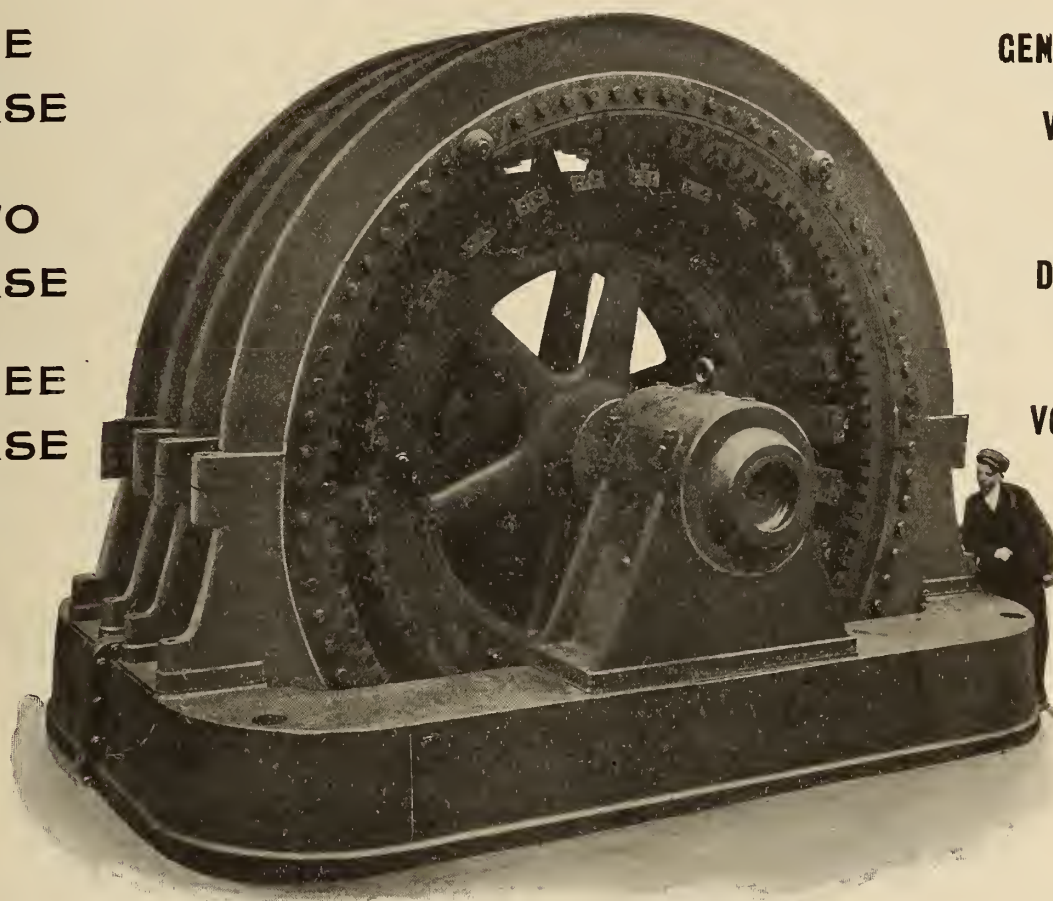
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(This cut shows Generator as it was being assembled.)

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SPARKS.

The firm of H. Chubb & Co., electrical supplies, St. John, N. B., has been dissolved.

The annual meeting of the Northwest Electric Co. was held at Winnipeg on May 20th.

The Sydney Electric Light Co., of Cape Breton, is now operating from an S.K.C. plant.

The Council of Wyoming, Ont., are said to be in favor of lighting the village by electricity.

The Charlottetown Light and Power Co., of Charlottetown, P.E.I., has been granted incorporation.

The Canadian Locomotive & Engine Co., of Kingston, Ont., will hold their annual meeting on June 14th.

It is expected that the new electric railway in St. Thomas, Ont., will have cars running during the present month.

It is said that Irwin Joyl, of Fulford, Que., intends putting in an electric plant for lighting his tannery and the streets of the village.

The Kingsville Electric Light Co. has placed an order with the Royal Electric Co. for a 500-light alternator and transformer.

G. D. Campbell, of Weymouth, N. S., has closed a contract with the Royal Electric Company for an electric lighting plant.

A committee of the City Council of London, Ont., will recommend that tenders be invited for a municipal electric light plant.

The employees of the Ottawa Electric Railway will hold their first annual excursion, to Gracefield, Que., on Sunday, June 19th.

A special committee of the Hamilton City Council will report at an early date on the question of establishing a municipal lighting plant.

An effort is being made to form a joint stock company at Shawville, Que., for the installation of electric light and waterworks systems.

The People's Telephone Co., of Windsor, Ont., has been incorporated, with a capital of \$25,000, to do business in Windsor, Sandwich and Amherstburg.

The authorities of the Grand Trunk Railway have not yet come to a definite conclusion regarding the adoption of electricity for hauling trains through the Sarnia tunnel.

A by-law to authorize the issue of \$12,000 of debentures for an electric railway between Waterloo and Galt, will be voted on by the ratepayers of Waterloo on the 10th inst.

William Snider & Co., of Waterloo, Ont., have recently put in a new arc dynamo supplied by the Johnson Electric Co., of Toronto, and have replaced their lamps by new ones.

The amalgamation of the Quebec and Montmorency Railway and the Quebec District Railway is said to have been effected.

The motive power of the former road will likely be converted to electricity.

Wood Bros., of Brantford, Ont., have installed a 70 h.p. S.K.C. synchronous motor, to operate from the lighting circuits of the S.K.C. generator owned by the Brantford Electric & Operating Co.

The C.P.R. Telegraph Department are building a new telegraph line between Montreal and Hamilton, to be used for railway work only. They are also building a line from Montreal to Megantic, Que.

The work on the large C. P. R. station and office building in Vancouver and the hotel at Revelstoke is progressing rapidly. Most of the materials were procured in the west, the steel structural work being supplied by E. A. Wallberg, Montreal.

The Montmorency Power Co., of Quebec, have purchased a 600 k.w. S.K.C. generator from the Royal Electric Co., this being the sixth S.K.C. machine of this size that they have installed, making a total altogether of 4,000 k.w. in S.K.C. generators.

The case of Easton vs. Brantford Street Railway Co. has been settled out of court, the company agreeing to pay \$400 and costs. The original verdict was for \$12,000, but this was reduced on appeal to \$9,000, when the company went into liquidation.

The Toronto Street Railway Co. has again appealed against their assessment of \$84,861 on rails, poles and wires. The Bell Telephone Company and C.P. R. Telegraph Company have also appealed, the former claiming that they are not liable, and the latter that they have no plant in ward one.

A prize of 1,200 marks is offered by the German Association of Mechanical Engineers for the best method of lifting and turning trains on the Berlin elevated electric railway. The competition closes at noon on the 20th October next. Full particulars are obtainable at the offices of the association, 80 Linden street, Berlin, S.W.

The electric street railway system of Dublin, Ireland, nearly all the machinery and equipment for which was furnished by United States manufacturers, has just been put in operation. The steel work for the boiler house, 131 x 76 feet, was furnished by Riter & Conley, of Pittsburg, Pa. Twenty Babcock & Wilcox boilers and two Green economizers were supplied by the respective companies, while all the valves and piping were made by the Crane Co., Chicago, Ill. "Stratton" separators, "Hunt" coal conveyors, "Wheeler" condensers and boiler feed pumps, and Reynolds-Corliss engines, built by the E. P. Allis Co., Milwaukee, Wis., are also included. The 500 k.w. generators were manufactured by the General Electric Co., as were also the car motors. The trolley wire, feeders, etc., came from John A. Roebbling's Sons & Co., and the trucks from the Peckham factories. The capital stock of the company is said to be \$1,200,000.

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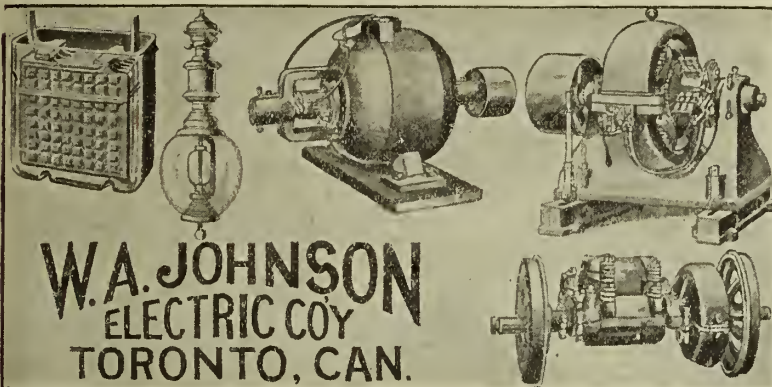
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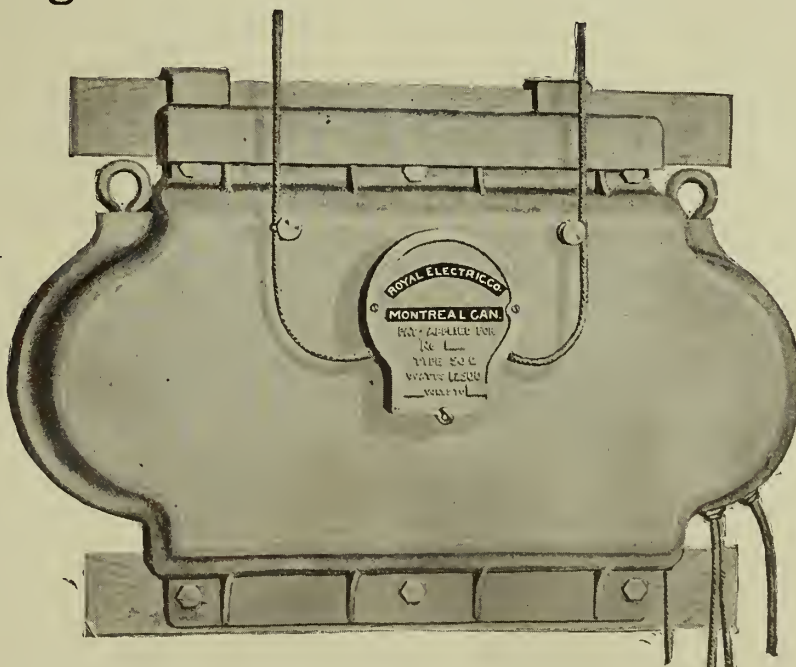
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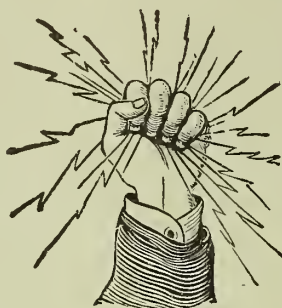
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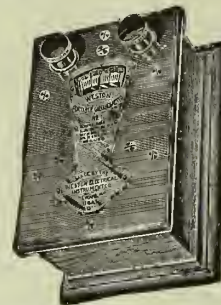
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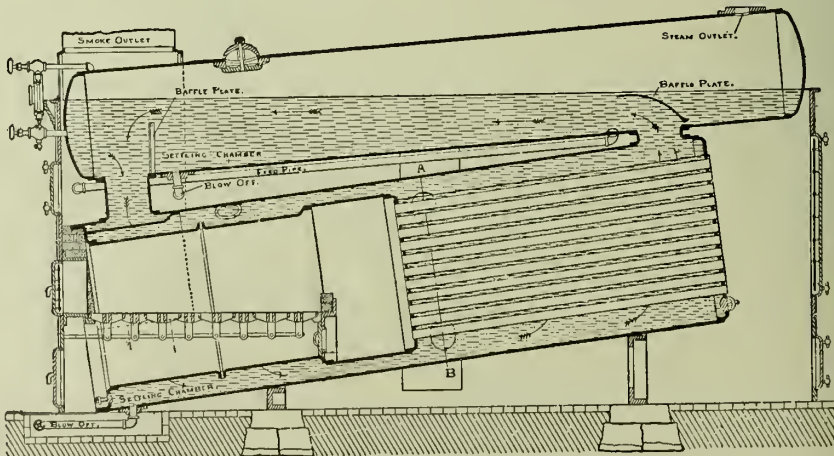
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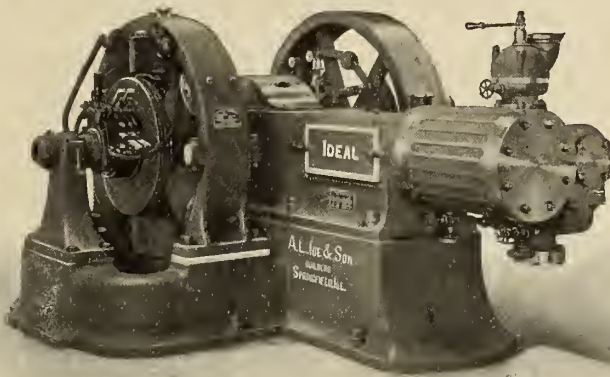
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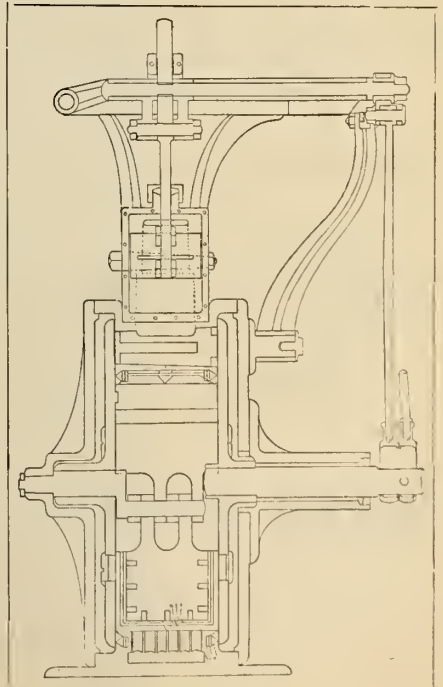
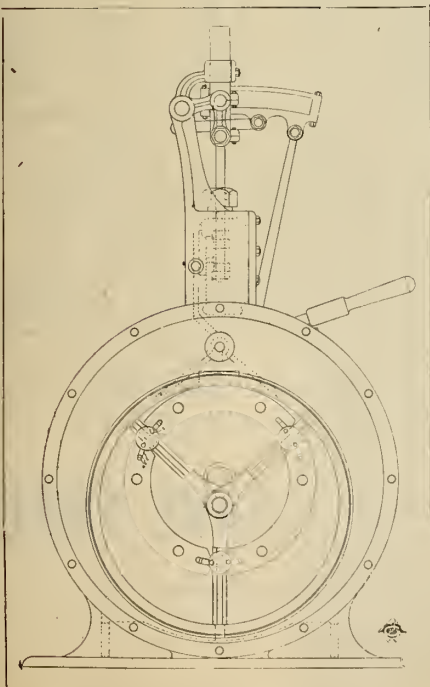
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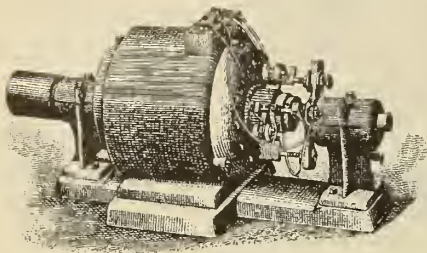


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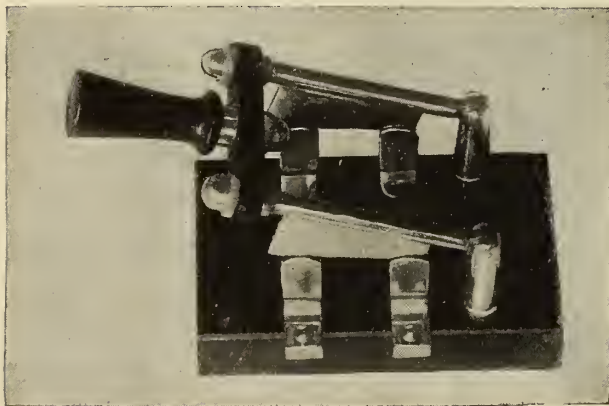
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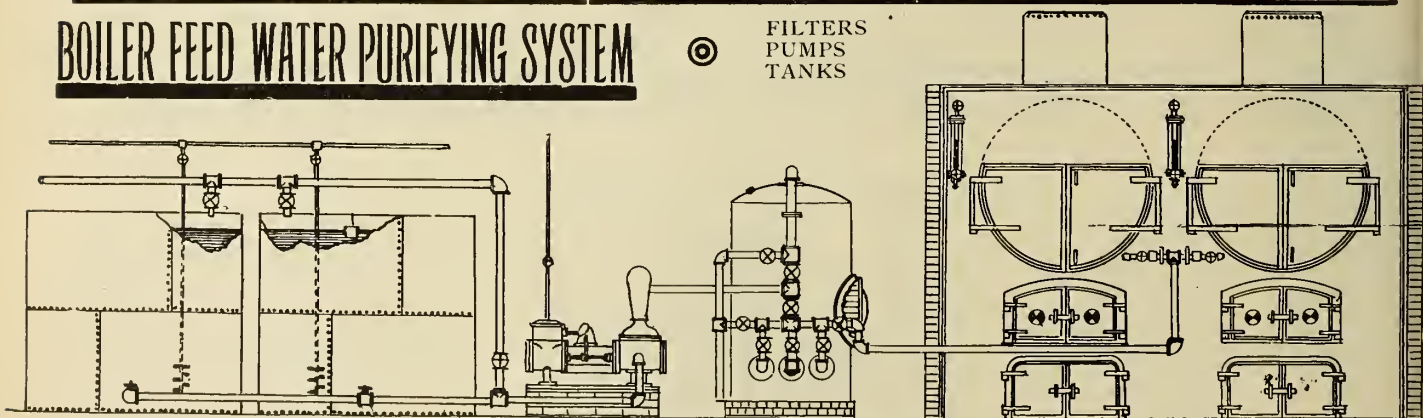
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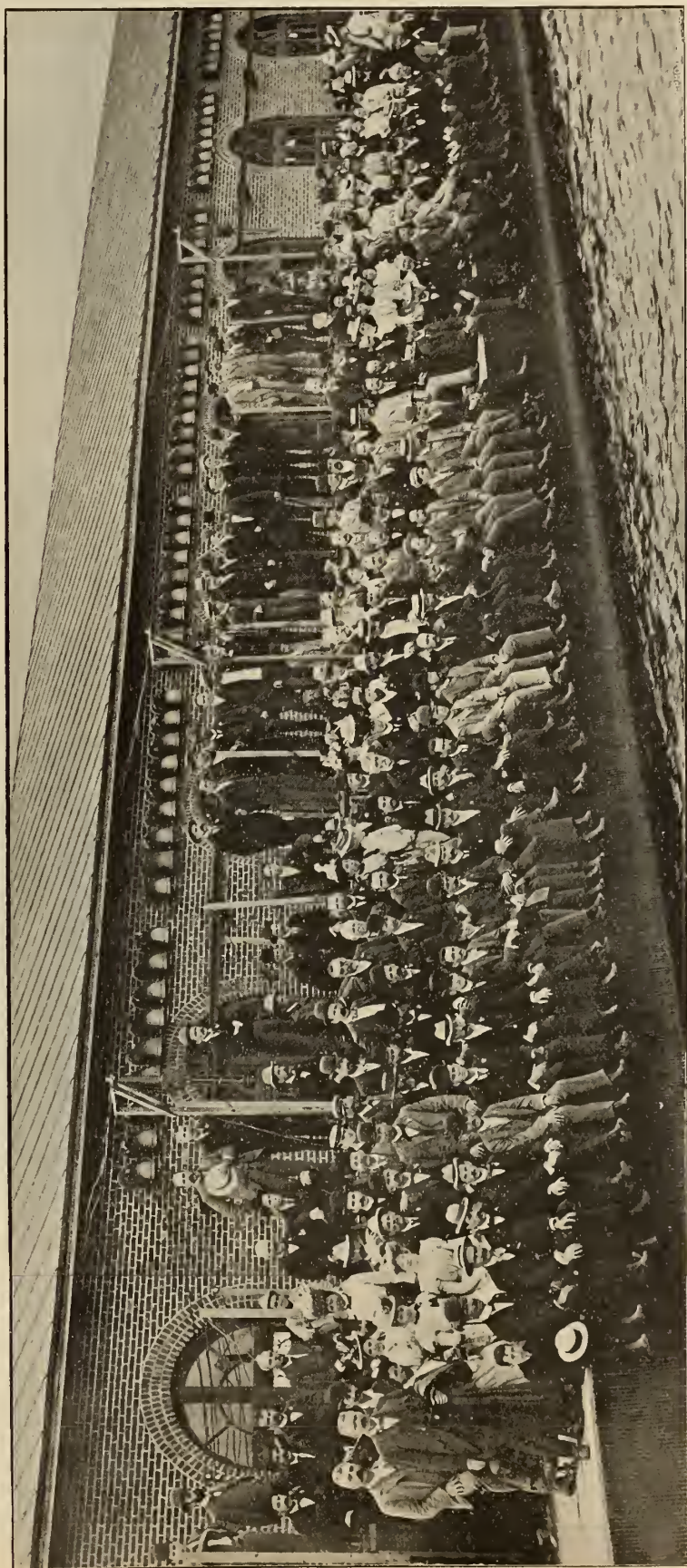
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CANADIAN
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STEAM ENGINEERING JOURNAL.

VOL. VIII.

JULY, 1898

No. 7.



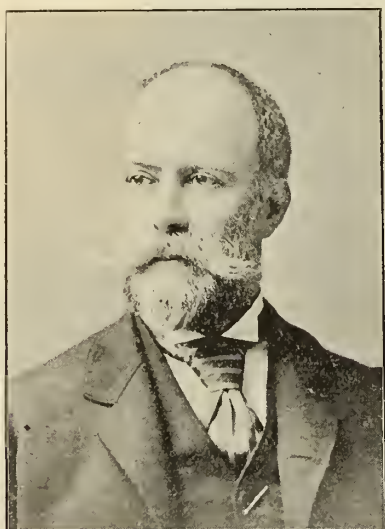
MEMBERS AND VISITORS, CANADIAN ELECTRICAL ASSOCIATION CONVENTION, MONTREAL, JUNE, 1898.

From photograph taken at Chambly.

MR. W. H. BROWNE.

The Canadian Electrical Association is to be congratulated upon having chosen Mr. W. H. Browne as its chief executive officer. Since his connection with the Association Mr. Browne has been recognized as one of its strongest pillars. Of his desire and ability to wisely direct the affairs and promote the interests of the Association there can be no question. His energy, earnestness and thorough business methods, as exemplified in the management of the Royal Electric Company, are sufficient guarantee on this point. In this he will be given valuable assistance by the two vice-presidents, Messrs. H. P. Dwight and A. A. Dion.

Mr. Browne was born in the year 1849, at Troy, N. Y. While engaged in the foundry and general hardware manufacturing business in the city of New York, he perceived the possibilities in the electrical field. Besides investing in other electrical industries, he became interested in and was one of the organizers of the electric railway at Richmond, Virginia, which was the first electric railway in the United States, the construction of which was commenced in 1888. He continued as manager of this road until 1891, and in addition had the



MR. W. H. BROWNE,
President Canadian Electrical Association.

management of the United Electric Light and Power Company, perhaps the largest concern of the kind existing at that time, which afterwards absorbed the United States Illuminating Company and the Brush Illuminating Company. In January, 1895, Mr. Browne accepted the management of the Royal Electric Company.

CONVENTION ECHOES.

Mr. Kammerer's pretty little Anglo-American flags were very much in evidence.

What's the matter with the new president and vice-presidents? Oh! they're all right.

Parlez vous Francais? If not, we may conclude that you are among the few who didn't attend the convention.

Mr. E. I. Jenking is not only a clever stenographer, but also an excellent singer and an altogether jolly good fellow.

Mr. F. A. Wunder, of New York, eastern manager for the Fort Wayne Electric Corporation, took in the convention. He was accompanied by Mrs. Wunder.

Three cheers and a tiger for the members of the Reception Committee—Jolly good fellows every one—when shall we see their like again? "Hip! hip!" etc.

The excellent work done in behalf of the Association by Mr. Yule during his two years' term as president is recognized and held in highest appreciation by the officers and members.

Mr. Samuel Chase, of New York, representing the Western Electric Co., of Chicago, is well known to the electrical fraternity in Canada, and consequently was right at home with the boys at Montreal.

Mr. R. E. T. Pringle's handsome electrical display on St. James street was highly commended, as was also that of the Lachine Rapids Hydraulic and Land Co., corner of Craig street and Victoria avenue.

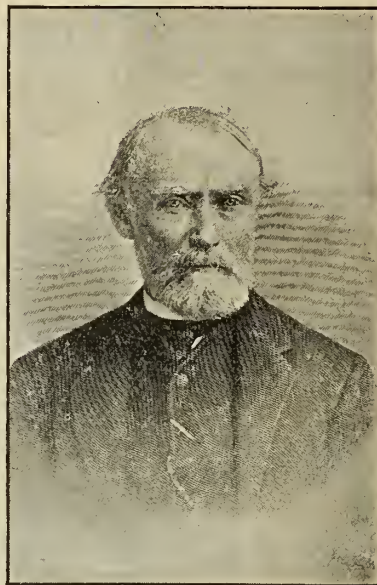
The absence from the banquet of Mr. C. F. Sise, president of the Bell Telephone Co., was much regretted. Mr. Sise is at present a victim of rheumatism, and therefore subject to the commands of his physician.

Conspicuous among the dispensers of hospitality throughout the

convention was Mr. L. B. McFarlane, of the Bell Telephone Company, who constantly exerted himself for the success of the meeting and the pleasure of the visitors.

The sight of the genial manager of the Toronto Electric Light Co., wearing on his breast the combined flags of Britain and United States, was accepted by the members as indisputable evidence of the genuineness of the entente cordiale which is said to have recently been established between these nations.

It is to be hoped that Mr. Wm. Thompson, the indefatigable chairman of the Committee on Arrangements, has found time



MR. H. P. DWIGHT,
First Vice-President Canadian Electrical Association.

since the convention to enjoy the sleep which was so conspicuously absent a feature of his existence during convention week. Mr. Thompson has made a reputation for himself as a "hustler."

In addition to a number of interesting samples of electric cables, Mr. John Carroll, of the Eugene Phillips Electrical Works, presented to his friends a handsome souvenir of the convention in the form of an attractively covered folder, containing excellent portraits of Admiral Dewey and other prominent American commanders.

The Canadian General Electric Co., Limited, of Toronto and Peterboro', presented the delegates to the convention with a handsome and serviceable souvenir, in the shape of a paper weight made in miniature to represent a small induction motor. This



MR. A. A. DION,
Second Vice-President Canadian Electrical Association.

little souvenir was much admired and highly appreciated by all who received one.

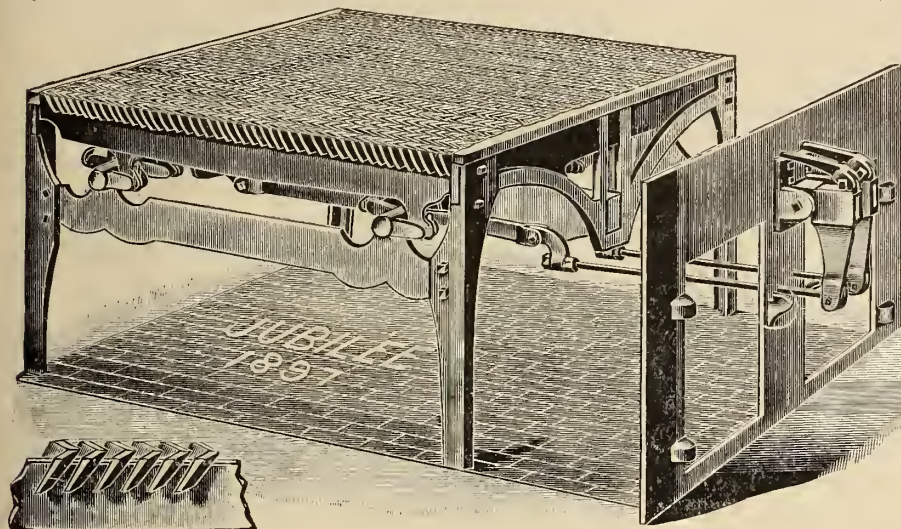
Some of the Montreal ladies were extremely thoughtful and kind to the wives and lady friends of non-resident members. It has been suggested that at future conventions, the pleasure of visiting ladies could be greatly enhanced by the appointment of a local committee of ladies, under whose direction points of interest might be visited during the progress of the business sessions.

Mr. H. O. Fisk, of Peterboro', took in the convention city, but not the convention. The why and wherefore of his absence from the convention hall and the good fellowship of his brethren in the Association was the subject of many conjectures. We now feel at liberty to state that Mr. Fisk was compelled to choose between electrical technicalities and the society of his young and pretty

bride, and he very wisely chose the latter. The members of the Canadian Electrical Association will join us in wishing the young couple a long and prosperous matrimonial voyage.

The wife of a well known member, who took in all the visits of inspection and asked the why and wherefore of everything she saw, has expressed her intention to prepare a series of lectures on electricity from a woman's standpoint. This preliminary announcement is made in order that the proposed departure may not prove too great a shock to the lady's husband and friends.

Mr. W. H. Browne, manager of the Royal Electric Company, and his excellent staff, placed themselves unreservedly at the disposal of the officers and members throughout the convention.



THE JUBILEE SHAKING GRATE.

It is needless to say to those who know them that they are a bright and cheery lot of good fellows, who do not count any effort too great that is calculated to increase the comfort and happiness of their friends.

Many of the members were glad to find Mr. R. G. Black, son of Mr. Geo. Black, of Hamilton, in charge of the Chambly Manufacturing Company's plant. Mr. Black, in addition to excellent natural ability, is a graduate of the School of Practical Science, Toronto, and has had a valuable experience in the factory of the Westinghouse Electric Manufacturing Co., at Pittsburg, Pa. Therefore in his present position he will no doubt prove to be the right man in the right place.

THE JUBILEE SHAKING GRATE.

We take pleasure in calling the attention of our readers to the merits of the Jubilee shaking grate. People who are interested in steam power and heating plants have been giving much attention to the cost of fuel used to generate steam, hot water or hot air, as the case may be. It has taken but little observation, when once put to the scrutiny of skillful engineers, to see that the old-fashioned way of burning coal on stationary bars, using hoes, slash bars, scrapers, hooks, slicing bars and other such fire tools to rid the ash and clean the fire did not prove an economical way of burning coal. This conclusion, settled by the observant engineer and fireman, opened the field for some appliance to take the place of the stationary bar.

It will be observed by the illustrations presented that the Jubilee Grate Bar Co. appear to have embodied the essential points required in the construction of a shaking grate. The bars stand erect upon the rockers, presenting a perfectly smooth and level surface to the fire. When shaking, the bars have an up and down movement which thoroughly sifts the ash from the coal, allowing the air free access to properly oxidize the carbon. It is claimed for these grates that they evaporate from 10 to 20% more water per pound of coal, using slack or screening, and with natural draft, than can be evaporated when using select, lump or best steam coal on a stationary bar. Below is a summary of the prominent features which distinguish the Jubilee shaking grate:

It gives the greatest percentage of air space of any grate in the world, thereby insuring the most perfect combustion; $\frac{3}{8}$ air space gives 57 per cent. air; $\frac{1}{2}$ air space gives 70 per cent. air; $\frac{5}{8}$ air space gives 78 per cent. air.

It has 50 per cent. more under-draft than any shaking or stationary bar made.

The angle sections which protrude above the body of the bar, and form the top or surface of the grate, are set at such an angle

that the air is carried in its natural line of flow without a break in its current, under and behind the coal.

Owing to the angular shape of the sections they gather the air in and over the top of the bar, thereby distributing the air evenly under the coal, besides keeping the bar cool.

It presents a perfectly level surface while at rest.

Owing to the perpendicular movement of the bars when shaking, the grate surface is cleaned equally without opening fire doors and without loss of fuel.

The Jubilee grate shakes from wall to wall, and has no stationary centre or side bars upon which the ashes and clinkers can collect.

The bars stand erect upon the rockers and are held in place by a projection on the end of the bars, which move in guides on end frames, which are well down below the fire, and by having nothing to interfere with expansion makes it impossible to twist or bend the bars.

The bars are held down to rockers by gravity hooks, doing away with the inconvenience of split pins and such methods.

It has a most unique and effective locking to hold the bars level.

It is easily adapted to any furnace.

It can be changed from one sized air space to another without removing anything but the bars.

These grates are manufactured and sold by the Jubilee Grate Bar Co., of Toronto, Limited, West Market street, Toronto; the Goldie & McCulloch Co.,

Limited, Galt, Ont., and the Laurie Engine Works, Montreal, Quebec.

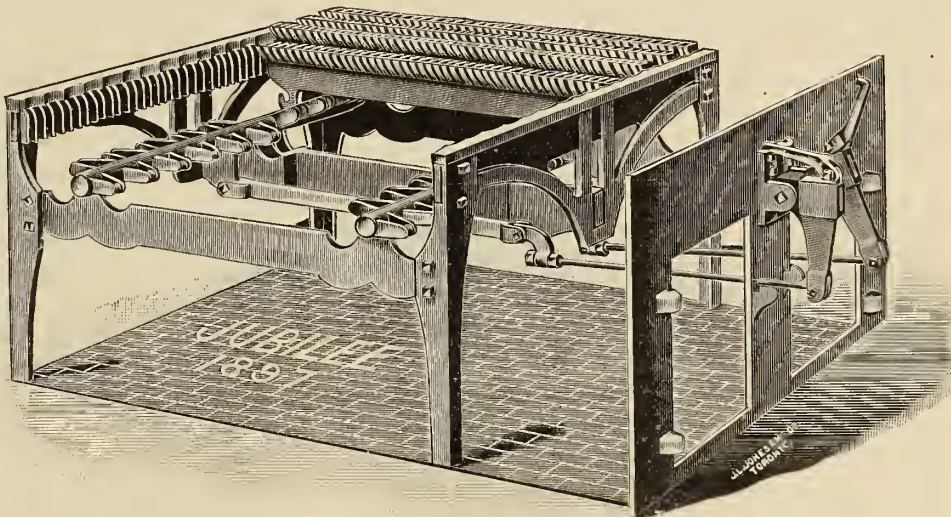
PERSONAL.

Mr. A. Bingham, manager of the Bell Telephone Co., has resigned, and has accepted the position of manager of the St. Thomas electric railway.

Mr. E. Round, of the Peterborough Light & Power Company, was a recent visitor at the office of the ELECTRICAL NEWS. Mr. Round has been connected with the above company for fourteen years.

Mr. I. H. Breck, electrician, of Kingston, Ont., is receiving the congratulations of his friends upon the occasion of his recent marriage to Miss McLeod. Mr. Breck is a son of the president of the Kingston Electric Railway Company.

Before leaving to assume his new position with Messrs. Dick, Kerr & Company, of London, England, Mr. F. C. Armstrong, late

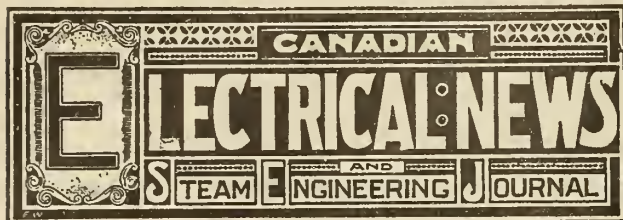


THE JUBILEE SHAKING GRATE, WITH SOME OF THE BARS REMOVED.

of the Canadian General Electric Company, was tendered a farewell dinner at the Board of Trade restaurant in Toronto.

McCurdy & Co., Antigonish, N. S., are enlarging their electric light plant, and have a contract to light the streets of the town. A 60 h.p. engine and boiler has been ordered from the Robb Engineering Co.

An effort is being made to form a company in London, Ont., in opposition to the Bell Telephone Co. It is stated that Messrs. Walter & Evans, of Detroit, and J. Minhinnick, F. B. Leys, T. Smallman, and others, of London, are interested, and that the charge for instruments will be \$18 for house service and \$25 for office service per annum.



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The "Canadian Electrical News" has been appointed the official paper of the Canadian Electrical Association.

CANADIAN ELECTRICAL ASSOCIATION.

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H. R. LEYDEN, Manager Cataract Power Co., Hamilton.

GEO. BLACK, G. N. W. Telegraph Co., Hamilton.

E. E. CARY, Manager Packard Electric Co., St. Catharines, Ont.

THE space required in this issue for a report of the proceedings of the convention of the Canadian Electrical Association renders it imperative that several articles previously arranged for be held over until our August issue. Among these are the last of Mr. Thompson's series of articles on "Corrosive and Scale Forming Agents in Boiler Feed Waters," and the conclusion of Mr. R. A. Ross' paper on "Electrical Power Transmissions."

Canadian Electrical Association Convention.

THE recent convention in Montreal of the Canadian Electrical Association was, without doubt, the most successful yet held. The arrangements were complete in every respect, the attendance large and representative, and the proceedings unusually interesting. At a meeting of the Executive Committee held prior to the convention, over sixty new members were elected. The Association is now in a prosperous condition, and continued growth is assured. Lack of space prevents a more extended reference to the convention proceedings.

Assessment of Poles, Rails and Wires.

ELECTRICAL companies will await with much interest the decision of the Privy Council in England with regard to the validity of the assessment imposed on the rails, poles and wires of the Toronto Railway Company, inasmuch as the result will affect not only street railway companies, but also gas, electric light, telephone and telegraph companies. In the city of Toronto alone, an assessment on the various companies of more than two million dollars is involved, which would give a yearly

revenue of at least \$34,000. The question has been before the Ontario courts for four years, but the decisions already given provide little ground on which to forecast the final result. The Supreme Court decided that the gas mains of the Consumers' Gas Company are liable to assessment; Judge McDougall held that the rails, poles and wires of the Toronto Railway Company are also liable to assessment. Judges McGibbon and Dartnell ruled that the above equipment of the Toronto Railway Company is exempt from taxation, but the Court of Appeal for Ontario has reversed this decision, and it is from this last decision, which is final until overruled by the Privy Council, that the appeal is now being taken. The question which the Privy Council must decide is whether or not the equipment, such as rails, poles, wires, mains, etc., of a company, is real or personal property. If real property such equipment is assessable; if personal property it is exempt from taxation, the Assessment Act of Ontario providing that the personal property of a company which invests the whole or the principal part of its means in gas works, waterworks, railways, and such like, shall be exempt from assessment. There are many debatable points in connection with the case, and no prediction as to the outcome can safely be ventured.

Cost of Power for Generating Electricity.

In a paper read before the National Electric Light Association, Mr. W. McLea Walbank, of Montreal, gives some calculations as to the cost of producing power from the Lachine Rapids for the generation of electricity. His estimate includes the cost of developing the power and delivering it on the bus-bars at the sub-station, in which the cost of step-down transformers and the drop or loss in power from the rapids to the station must be taken into consideration. Of a total installation of 72 wheels, 48 are already in place. About \$1,000,000 has been spent in hydraulic development, which will furnish 20,000 horse power, but until a market is found for the total power, some 5,000 horse power will have to be charged with the expense of hydraulic development of the total 20,000 horse power. Therefore Mr. Walbank, in his paper, gives, first, the cost per kilowatt per year for the portion of the plant at present installed, and, second, the cost when the whole water power development will be in operation. In the first instance the cost of water rights, hydraulic machinery, etc., is \$957,200, and the power delivered at sub-station, allowing for loss, 3,600 kilowatts, which is equivalent to \$263.83 per kilowatt, capital cost. This, at six per cent., would be equivalent to \$15.95 per k.w. The depreciation on \$300,000, representing the cost of that portion of the plant subject to depreciation, at 5 per cent., would be \$4.17 per k.w., and the operating expenses, including repairs, insurance, etc., \$2.85 per k.w., giving a total cost on a twenty-four hour day basis of \$22.97 per year per kilowatt. Taking the completed plant, with 72 wheels installed, the cost is given as \$1,113,273. The power developed, after deducting losses, will be 13,500 kilowatt at the bus-bars, equivalent to \$82.46 per h.p. capital cost, which, at six per cent., represents \$4.95 per kilowatt annually. Allowing \$1.68 per k.w. for depreciation and \$1.51 for operating expenses, the total cost per annum will be \$8.14 per kilowatt. Attention is directed to the fact that the operating and depreciation expenses per kilowatt will be very much reduced when the entire hydraulic equipment is put into operation. It is stated that Nova Scotia coal, costing \$3.50 per ton, is used.

CANADIAN ELECTRICAL ASSOCIATION

PROCEEDINGS OF THE EIGHTH ANNUAL CONVENTION

THE Eighth Annual Convention of the Canadian Electrical Association was held, pursuant to announcement, at the Windsor Hotel, Montreal, on Tuesday, Wednesday and Thursday, June 28th, 29th and 30th.

The first session opened at 10 a. m., with the President, Mr. John Yule, in the chair.

There were present the following members :—

L. B. McFarlane, John J. York, H. O. Edwards, F. W. Fairman, John Shaw, Wm. B. Shaw, John Carroll, P. H. Hart, N. W. McLaren, Fred Thompson, E. Craig, C. H. Wright, Geo. W. Sadler, R. S. Kelsch, W. E. Gower, George A. Childs, James A. Baylis, Moses Rubenstein, N. C. Ross, D. S. Barton, Wm. T. Bonner, Wm. H. Browne, J. E. Scott, M. P. Cochrane, Louis A. Herdt, P. G. Gossler, L. D. W. Magie, H. J. Fuller, Thomas Rodger, D. W. McLaren, P. H. Davidson, George E. Mathews, Alex. Barrie, E. Carter, W. B. Powell, H. H. Henshaw, R. E. T. Pringle, A. W. Staveley, H. G. McLaren, Wm. F. McLaren, W. McLea Wallbank, J. A. Burns, R. Dobie, L. A. Howland, E. A. Wallberg, F. H. Leonard, jr., W. J. Plews, J. W. Pilcher, D. Sleeth, Montreal, Que. ; W. A. Johnston, Wm. McCaffrey, E. B. Biggar, A. M. Wickens, A. B. Smith, J. J. Wright, J. W. Campbell, Walker G. Anderson, E. D. McCormack, Joseph Wright, J. K. Johnstone, J. J. Ashworth, C. H. Mortimer, J. A. Kammerer, Toronto, Ont. ; A. A. Dion, W. G. Bradley, Wm. Ahearn, jr., C. Thompson, E. J. O'Reilly, James Johnston, R. Anderson, Ottawa, Ont. ; F. W. Martin, George Black, John P. Rigsby, Gordon J. Henderson, Hamilton, Ont. ; Charles B. Hunt, C. E. A. Carr, London, Ont. ; B. F. Reesor, Thomas Sadler, D. McGribben, P. Morgan, Lindsay, Ont. ; E. E. Cary, D. H. Henderson, G. A. Powell, St. Catharines, Ont. ; W. R. Leet, E. A. Wright, Danville, Que. ; J. J. Mahoney, Samuel A. Chase, W. R. McLaughlin, F. A. Wunder, New York, N. Y. ; John Yule, Guelph, Ont. ; William Thompson, Montreal West, Que. ; J. W. Purcell, Walkerville, Ont. ; Geo. D. Ellis, Barrie, Ont. ; A. A. Wright, Renfrew, Ont. ; H. A. Moore, Trenton, Ont. ; W. F. Simmons, Kingston, Ont. ; A. L. Breithaupt, Berlin, Ont. ; V. B. Coleman, Port Hope, Ont. ; E. J. Kyle, Merrickville, Ont. ; J. F. H. Wyse, Brantford, Ont. ; Andrew Sangster, Sherbrooke, Que. ; Alfred Stearns, Brussels, Ont. ; W. A. Fenn, Buffalo, N. Y. ; J. A. Hunter, Vancouver, B. C. ; Stephen Noxon, Ingersoll, Ont. ; P. Bowler, New Westminster, B. C. ; George W. Thompson, Belleville, Ont. ; S. E. Fletcher, St. Johns, Que. ; H. R. Caruthers, Millbrook, Ont.

The Secretary-Treasurer read the minutes of the last annual meeting of the Association, held at Niagara Falls, June 2nd, 3rd and 4th, 1897, which were approved.

His Worship, Mayor Prefontaine, of Montreal, was then introduced to the President and the Association, and made the following address :

Mr. President and Gentlemen :—In the name of the citizens of Montreal, I heartily welcome you to our fair city. The Association to which you belong is one of the most important Associations of the century. The science which you study is one which can be called the science of the 19th century, although immense progress and discoveries had been made previous to then.

It is not necessary for me to enlarge more upon the question, as I hope that I will have the pleasure of meeting you at the banquet, but this morning, let me only repeat again that we are glad to see you here amongst the citizens of Montreal.

I know the work you will do will bear fruit as regards the prosperity of the science which you study.

I, therefore, as chief magistrate of the city of Montreal, declare the eighth annual convention of the Canadian Electrical Association to be open, and I trust your stay will be pleasant, and hope that you will be favored with fairer weather than you were this morning, as otherwise you will obtain a poor opinion of our climate.

I hope the stay that you will make in the city of Montreal will be both useful and enjoyable.

The President : We are all very much pleased to see His Worship here, and I call on Mr. Wright, of Renfrew, to thank him for his kindly address.

Mr. A. A. Wright : I am very sorry for two things—one is that I was not born a French-Canadian, in order that I might have all the eloquence which, you know, is supposed to flow in the veins of those good people ; and another thing for which I am sorry is that I was not born in Ireland, in order that I might have lived near the "blarney stone." I may say that I have made full arrangements that when I come to be born again, all

these little difficulties will be overcome. I am sure that, as an Association, we are delighted with the flattering address which has been made to us by His Worship, the Mayor of Montreal, and the hearty welcome ; and in looking over the programme that our good friends here have arranged for us, I am sure that there will be only one opinion with regard to the excellence of it. You know that entertainments such as these are not sold by the pound, as the grocer sells his tea, nor by the yard, as the dry goods man sells his cotton, but they are the spontaneous outcome of noble and generous hearts, and those are the kind of hearts possessed by the citizens of Montreal. This is a progressive and illustrious city. Cities are made of men, consequently the people of Montreal are illustrious, because we have in the city of Montreal some of the most illustrious and liberal men on the face of the globe—liberal to the art of electricity—and we believe they have done and will do all they can to make this meeting one of the best we have ever had. I thank His Worship, the Mayor, for his kind address, and we thank the good people of Montreal for the entertainment we expect to receive while we are here during the next few days.

The President then read his annual address, as follows :

PRESIDENT'S ADDRESS.

I beg to give you all a hearty welcome to this the eighth convention of the Canadian Electrical Association. The aim of the Association is to gather together the members of the electrical fraternity and allied interests for the purpose of mutual discussion, and to learn from each other's experience. In this way we try to benefit the whole business interests with which we are all connected. An organization of this kind confers upon its members benefits from the reading of papers, and the discussions which take place disseminate information with reference to the methods that are constantly being tried by different members in the practical conduct of their every day operations and business methods. This Association affords the means for members to become acquainted with one another. The friendships here formed should be used for the purpose of mutual protection and advice when difficulties arise. A free and friendly correspondence tends very much to strengthen, stimulate and encourage many of us in our daily struggle with difficulties. It is a matter of satisfaction to me that during the last two years you have honored me with the office of President, good progress has been made in the direction indicated ; but there is still room for great improvement.

It is now almost four years since the last meeting of the Canadian Electrical Association was held in the city of Montreal. During the interval conventions have been held, once in Ottawa, twice in Toronto, and last year at Niagara Falls. On each occasion matters of current interest and importance have been presented for the consideration of our members. There are many reasons why our meeting again this year in the east, and particularly in Montreal, should be at once a source of both pleasure and profit to the members of this Association. The intervening four years have done much for the Dominion of Canada, for its national life and the development of its material resources. In no department of industry has this progress been more marked than in the electrical field, in electric lighting, in electric railway work and in the electric transmission of power ; and the work must not be forgotten which has been done in extending the use and improving the service in the older branches, the telegraph and the telephone. From this development of the great modern industry in which we are all proud to have a share, no part of the country is likely to reap greater benefits than the city of Montreal and its vicinity. The Dominion of Canada, at least so far as Ontario and Quebec are concerned, while otherwise abundantly dowered with mineral riches, has been deprived of coal deposits, until recently an essential factor in manufacturing and industrial development. To-day, however, the possibilities of electrical transmission have rendered available as a substitute to turn the wheels of our factories, the heritage which both provinces possess in their abundant water powers. It will be our privilege to inspect what has been done in this direction by some of her far-sighted and enterprising citizens for the city of Montreal. We shall first see that great enterprise, carried out in the face of difficulties and discouragements, the successful utilization of the power of the St. Lawrence river by the plant of the Lachine Rapids Hydraulic and Land Company. Of equal interest and importance will be the opportunity given of inspecting the plant and equipment of the Chambly Manufacturing Company on the Richelieu river at Chambly, which will vie with its great rival in the beneficent work of supplying cheap light and cheap power for the citizens of Montreal. It is to be hoped that a fair dividend will be the reward of the shareholders of the two companies for their enterprise.

It is proper, before entering on the work of this convention, that

we should glance briefly over the progress of the past year. A marked feature of electric progress in the Dominion throughout the years 1897 and 1898 has been the inception, and, in some cases, the completion of a number of important plants for the long distance transmission of power. In the province of Quebec there are, besides the two plants already mentioned, the Montmorency plant, which has been in operation for several years, and is no doubt familiar to most of you, and the North Shore Power Company, Three Rivers, a 16 mile transmission, 12,000 volts, delivering 500 k.w. In Ontario there is the Cataract Power Company, of Hamilton, the distance to be transmitted 33 miles, pressure 25,000 volts, with a capacity of 6,000 horse power. This plant, it is anticipated, will be in operation by August 1st next. In British Columbia a transmission installation of 1,500 horse power capacity is being erected to supply energy for the electric railway, lighting and power industries of the city of Victoria, distance 16 miles. The West Kootenay Power Company recently started with an initial capacity of 2000 horse power, pressure 20,000 volts, distance 30 miles. This power will be used for the operation of machinery in the mining districts. We have already referred to the enormous development under way in the vicinity of Montreal. The only point at which satisfactory progress cannot be reported is at Niagara Falls, where, unfortunately, the tying up of the greatest water power in the Dominion in the hands of an alien corporation has prevented its development for the benefit of the people of Ontario. This state of affairs, we trust, will be removed before another year.

Besides the important plants mentioned which are either in operation or in course of construction, a large number of similar enterprises are at present in their initial stages and may be expected to reach their completion within the next year or two. Altogether, it is difficult to foresee at the present moment the benefits which our Canadian manufactories and industries generally may derive from the utilizing of the water powers of the country, scattered without number from the Atlantic to the Pacific. In electric railway work the development of the year has been mainly confined to the extension and the better equipment of existing city and suburban roads. In the field of electric lighting, in which a majority of the members of the Association are more particularly interested, a reasonably satisfactory condition of affairs exists. That industry is on a fairly solid basis, at least in so far as a distribution of current for incandescent and power purposes is concerned, as rendered evident by the failure of the much talked of illuminant of the future, acetylene gas, to make any inroad into the field of the lighting companies. A large majority of the plants now in operation are equipped with reasonably modern and efficient machinery, and the rates at which current is supplied are, it is safe to say, if taken on the average, the lowest in the world.

We will have before us the report of the Committee on Legislation. From this you will see how far the efforts made since our last meeting have been successful in the direction of securing equitable protection of private investments. It is to be hoped that the work of the Association during the convention will be helpful to the members, and that they will recognize the value they receive from their attendance here with respect to the papers which have been prepared for the convention. You will see their practical and helpful nature, and I trust you are ready to criticize and discuss the views set forth in the light of your own experience.

One thing more I feel should be mentioned, and that is, the appreciation of the efforts of the different companies and individuals in Montreal who have so heartily co-operated for the success of this meeting. The proverbial hospitality of our metropolitan city is known to you all. A pleasing feature of our last convention was the regular and prompt attendance of members at all sessions and the keen interest taken in the proceedings. This commendable practice will, I trust, be kept up at this our eighth convention now open for business.

The conclusion of the address was greeted with prolonged applause. The President then called on Mr. J. J. Wright to read the report of the Committee on Meters.

Mr. Wright stated that there was no special business to bring before the Committee on Meters during the past year, consequently it was not convened, and there was no report to make on behalf of it.

The President appointed Messrs. Reesor, Smith and Hunt as members of a committee to strike the standing committees for the year.

The President: The next item is general business that any of the members may wish to bring up, or any questions they desire to ask. We will be very glad to hear from anybody who has anything to say.

Mr. C. B. Hunt: I would move that the Report on Legislation be taken up the first thing to-morrow morning. This will give the members a chance to read it over; we cannot very well discuss it until this has been done.

The President: This appears to be all the business set down for this session, but I think it advisable to now have one of the papers read, and will ask Mr. A. A. Wright to read his paper entitled, "How to Overcome Some of the Difficulties Encountered by Central Station Men." (See page 143.)

DISCUSSION.

Following the reading of his paper, Mr. Wright made the following remarks: If I may be allowed the

time, there is one thing more that I wish to refer to. Perhaps it cannot be done in every instance, but there is one thing I would advise central station men to do, that is, where they have contracts with a town—unless they are situated under very favorable conditions, as in some certain towns that I know of, where the owners of the plant pretty nearly own the town itself, where you do not own the town, but the town, rather, owns you, so far as electric lighting is concerned—I would advise everyone to try and form a joint stock company, and not endeavor to run the concern alone, no matter how great their abilities are. Try and get the most influential men in the town as members of the company, and in that way you will have a leverage on the council that you cannot otherwise possibly obtain. It will also prevent other companies from coming in, and will assist you in many ways. I just throw out this as a suggestion, so that if anyone contemplates the formation of a joint stock company, they will try and get as influential men as possible, as it is hard to know sometimes where the lightning will strike. Another thing I would like to mention is that it is well to try and let your lighting contract with the town be the weak arm of your strength, and devote more time to the commercial aspect than to the other; then if you do not get the desired legislation, you will be in a better position to stand the shock than otherwise.

The President: We have listened to Mr. Wright's interesting speech, and we would like to hear from others as to their experience on any of the points mentioned by Mr. Wright. Mr. Wyse, of Brantford, may be able to say something.

Mr. Wyse: I have listened with a great deal of interest to Mr. Wright's paper, especially as it covers many points in relation to experiences that I have lately been through in dealing with the municipal authorities at Brantford, and I think it is something that all central station men and probably very many others can appreciate. There was one point that I would like to ask Mr. Wright about, and that is the collection of bills. He speaks of collecting weekly. Would you not, Mr. Wright, find that this would require a larger office staff than otherwise.

Mr. Wright: That refers to the arc lighting accounts. The man who goes around trimming collects these bills and the incandescents are collected every month.

Mr. Wyse: I thought that referred to your private incandescent customers.

Mr. Wright: No, we collect those monthly.

Mr. Wyse: We find that there are a great number of customers who, as you say, will pay a small bill rather than let a large one run on. There was another thing that I would like to bring to the attention of the members, that is, giving notice. We find that giving notice where the account is not paid promptly is very effective. We have a system of first, second and third notice, and if the bills are not paid after the third notice we disconnect the customer, and this generally results in his paying the bill and asking for re-connection. I think Mr. Wright deserves the thanks of the Association for his very valuable paper.

Mr. Wright: With reference to the insertion of that saving clause, this year I just succeeded in getting it, to use a common phrase, by the skin of my teeth—"one day saved me." It is very difficult sometimes to get that clause inserted. You all understand that there are certain men in the council that you can approach and others that you can not. Just how to get this clause inserted is often difficult. Some of you, I suppose, have sometimes to make up a contract yourself. It don't do to come out straight and say "Here, I want to have this resolution moved," especially as one has to deal with a number of men who are not any too well up. Be sure in making up the resolution to give it to a man who will bring it into the council without any hesitation. This is one of the difficulties I find in getting the thing brought before the councillors.

Mr. Wyse: Could you not arrange to get a longer contract than one year in most instances?

Mr. Wright: I would like to do so.

Mr. Reesor: What is the population of Renfrew?

Mr. Wright : Between three and four thousand.

Mr. Hunt : Do you supply incandescent lights entirely by meters or on flat rates ?

Mr. Wright : Almost entirely by meters.

Mr. Hunt : Do you charge a meter rental ?

Mr. Wright : Yes ; twenty-five cents a month on all sizes.

Mr. Hunt : What is the smallest size meter that you have ?

Mr. Wright : $7\frac{1}{2}$ ampere, 3 wire, and we also use 2 wire.

Mr. Hunt : You can now get 5 ampere meters for your 2 wire service that will start on a 5 c.p. lamp.

Mr. Wright : I did not know that there was one that would respond to a 5 c.p.

Mr. Hunt : There is, and we have about 50 in use of the General Electric type.

Mr. Wyse : The Shallenberger meter can also be obtained in 5 ampere size.

Mr. Reesor : As far as Lindsay is concerned, we make monthly collections on incandescent lighting, and the town lighting is also collected monthly. The incandescent lighting and commercial lighting we collect monthly, and we have a rate of discount of $33\frac{1}{3}\%$ if the bills due on the 1st are paid before the 10th. We find this works fairly well. They come to the office and pay, and we are trying to have all of our collections made at the office instead of sending out collectors. Of course we have a few delinquents, but we are trying to weed these fellows out, or educate them to a better system.

Mr. A. A. Wright : Have you everything in your own hands ?

Mr. Reesor : Yes ; we had two companies, but the other one has been absorbed.

Mr. A. A. Wright : Of course you can see the advisability of collecting your arc accounts every week instead of monthly. We could not work that lamp scheme with them.

Mr. A. L. Breithaupt : I find the system of sending notices very effective. We have in Berlin a number of customers who are intentionally delinquent, and who simply do not want to pay their bill, though they want the light. We found a very effective way to be to send them notice that unless within 48 hours the account was paid, the current would be cut off. We applied that both to our electric and gas customers, and find it works very well. We collect monthly, and try to render our accounts on the 1st. Sometimes they don't go out until the 2nd, and if paid by the 10th we allow 20% discount, that is, bringing it down to a net basis. Most of our bills are paid in the office, except a few of the business men near our office, which we collect ; but most of our people pay at the office.

Mr. A. A. Wright : You have no opposition in your town.

Mr. Breithaupt : No.

Mr. Wyse : I would like to ask Mr. Wright if he has any opposition in Renfrew.

Mr. Wright : Oh ! we have two others.

Mr. Wyse : In a town of 3,500 ?

Mr. Wright : Yes. Why, in Eganville, which has a population of about 1,500, they have two companies, and pay \$50 to the government—\$25 each.

The President : Mr. Wright speaks about gathering influential men about you. The great trouble about these men is that they don't stay influential, and don't stay with the council, but stay with the company, and sometimes incur the hostility of the aldermen for not being in harmony with them. In our campaign, I made up my mind that it had to go to the vote. I did not speak to a single member of the council until the whole thing was over, but just prepared, and let it go through, and about two weeks before the by-law came out I got in my work, and instead of them hunting me, they were on the defensive themselves. I had been preparing carefully for six months. The situation was such that I did not think it was any use to deal with the council at all, but simply stand on common sense and put your case before the freeholders. Fortunately in Ontario it is only those who have property that can vote on a by-law, and this is a large protection. There

is an inclination among the property holders not to trust the council with any more money or property than they can get at present. Referring to the system of collecting and sending accounts, we have weekly, monthly and quarterly accounts. The quarterly are the residences and best business places and the stores. The monthlies are billiard rooms, barber shops and taverns, and any customers whom we think it best to place on the monthly. For the weekly, as well as the monthly, we have a collector who calls for the account, but the quarterlies are paid at the office. We have arc, incandescent and power—in fact, a little of everything. In a small town such as we have, we know everybody and know how to handle everybody, whether as individuals or classes, and can tell the best way to treat them.

Mr. A. A. Wright : Although we present our accounts every month, circumstances will, as you say, alter cases.

Mr. Wyse : Could you not save the expenses of that collector by offering a discount off the bills if paid at the office ?

The President : You know all these discounts are put on before they are taken off. They are looked upon as a penalty, not as an advantage. The way I look upon discounts, with about 10,000 inhabitants, it is more a penalty than a reduction on the account.

Mr. Dion : I would like to say a word regarding 5 c. p. lamps. We supply lamps free to our meter customers. We have confined ourselves to 10 and 16 c. p. lamps, but a few years ago, customers finding out that lamps of 5 c. p. were made, asked for them to be used as night lamps. Most of our small customers could not afford to burn a lamp all night if it were 10 c. p., and we finally decided to let a customer have a 5 c. p. lamp, only supplying one, and when that burned out exchanging it for a new one. We found it popularized electric lighting in that way, and prevented customers from using coal oil lamps. These night lamps, while not registering on the meter, are small expense to the company, as the load is small at the time when they are used, and we have found it an advantage to allow them to be used in that way.

Mr. Reesor : Sometimes when we make contracts with flat rates for 16 c. p. lamps, we have had difficulty by reason of our customers placing 32 c. p. lamps in their stead.

Mr. Dion : We have a small number of customers on flat rates where there is danger of changing 16 c. p. lamps for 32 c. p., but we make an inspection of all these premises three or four times a year and have reports made so that we can keep a pretty fair check on the lamps.

Mr. Reesor : Where are you living ?

Mr. Dion : In Ottawa.

Mr. Hunt : I would like to ask Mr. Dion whether he supplies on both flat rate and meter systems.

Mr. Dion : About an eighth of our business is a flat rate one. We supply the lamps in the first installation and renewals are paid for. On the meter system we supply all lamps free—both first installation and renewals. I may say we do more than that. We have found that customers on the meter system allow their lamps to get very old and black until they hardly give any light and then complain to their friends without coming to the office, so that we have no means of remedying the difficulty. Now we have a house to house inspection for the purpose of putting things in order. The inspector gives attention to loose sockets, etc., and also replaces any lamps that had better be out of service. Although an expense, we think the satisfaction to customers more than reimburses us.

Mr. Ellis : Referring to collections, I think we have a unique system of collections in Barrie. We send the account out every six weeks. We have a form with a coupon on the end, which states that "this bill is payable at the bank 15 days after date of issue." If not paid at the bank, customers don't receive the discount. If tendered after the 15th day, the bank won't accept it. We find this system very successful. We pay the bank \$50 a year.

Mr. Hunt : What do you do with the person who does not pay and lets the account run ?

Mr. Ellis : When the bank make their returns, we use for delinquents a printed slip which says : "Your account payable at the Bank of Commerce is still unpaid. If not paid within 10 days, your light will be shut off and the account placed in the hands of our solicitors for collection." The discount granted is 30 per cent.

Mr. Hunt : If a customer pays on the second month, will you allow the discount ?

Mr. Ellis : No ; we keep charging the discount.

The President : I never went to court with a single customer.

Mr. Ellis : We very seldom find it necessary, and of course have to make allowances with some people. Sometimes it is impossible for them to pay at the bank, owing to their being absent from town, etc., and if only a day or two late we don't mind, but the other class of people we don't accept.

Mr. Wyse : How do you arrange with your customer for cash discount ?

Mr. Ellis : In sending the bill, we put down the gross amount and deduct the cash discount to be allowed. The contract is made at the gross price.

Mr. Hunt : What do you charge per 1,000 watts ?

Mr. Ellis : We charge $17\frac{1}{2}$ cents per 1,000 watts net, and if the bill is over \$12 in six weeks, we give a discount of 20 per cent.; our gross rate is 25 cents per 1,000 watts.

Mr. Browne : Do I understand that you give 20 per cent. discount from $17\frac{1}{2}$ cents net in cases where the bills are \$12 in 6 weeks ?

Mr. Ellis : Yes.

Mr. Hunt : I have great pleasure in moving a hearty vote of thanks to Mr. Wright for his very valuable paper and for the discussion that it has brought out. I think it has been very beneficial to all of us.

Mr. A. B. Smith : I have great pleasure in seconding that, and I hope Mr. Wright will have the same success with his city fathers in the future that he seems to have had in the past.

The session was then adjourned until 2:00 p.m.

AFTERNOON SESSION.

The convention resumed at 2:00 p.m.

The President read a telegram from the Ottawa Electrical Association, wishing the convention success, profit and pleasure, sure to be derived from a meeting in the Canadian metropolis.

Mr. Magie's paper on the "Electrical Utilization of Water Powers" was then read by Mr. W. H. Browne. (See page 139).

DISCUSSION.

Mr. A. A. Wright : If not out of order, I would like to ask if the position of permanent reader of papers is open ; if it is, I would like to move that Mr. Browne be offered the situation. (Laughter.)

The President : This is a very important paper, and I would like you to carefully discuss it and ask any questions you may wish.

Mr. Wm. Thompson : I really have to regret that I did not have the opportunity of seeing Mr. Magie's most remarkable paper before, and I say "remarkable" advisedly, because he has covered the whole ground, which is something that writers of papers seldom do. I regret that this paper has only reached our hands to-day. I can quite understand that Mr. Magie, the writer of this paper, is not to blame for this, because, as we all know, he is a very busy man, but this paper covers too many important points in electrical engineering to enable one to attempt to thoroughly discuss it without thorough study. There are, however, one or two points brought out very forcibly, and those of us who have felt the progress of electrical engineering during the last five or ten years, can appreciate the importance of the information that is given within the columns of this paper. I, myself, have barely turned 30 years of age, and still I can distinctly remember my grandfather who ran a mill in Yorkshire, having in operation one of those huge wheels about 30 feet diameter. I can distinctly remember a "chap," as they would say, coming up

from London and asking why he did not have buckets attached so that the water could drop into them. These were put on, and it was a remarkable fact to me that that mill, instead of turning out a few barrels per day, increased its capacity by more than four times. To my mind, the most important point in Mr. Magie's paper is the fact that evidently water wheels and water motor installations have come to stay. We have this evidenced by plants all over Canada, some of which have been very successful, others almost total failures. As it is the investor who produces the money for the electrical engineer to carry out his ideas, it is wise to remember that there are times when such installations as these are not advisable. I feel almost sorry that our large installations in the vicinity of Montreal are not further advanced, so that we could see or begin to appreciate the profits which the investor will receive from his capital in those large concerns. While passing Lachine Rapids one day I noticed that they had only two generators running. Now, they have a capacity there of something like 20,000 h.p., and they have been operating this plant for some little time. Possibly the total expenditure has been in the vicinity of a million and a half, but it struck me that there was going to be an immense lot of capital tied up in that plant for years to come without its earning any profit for the investor. If this had been a steam plant installation, it could have been made as the plant was required. This opens a large field for discussion, so much so that I do not feel like entering it, because I might, to use a vulgar expression, "put my foot in it." For this reason I would like to have had time to study Mr. Magie's paper very carefully and have prepared myself, and I feel almost like asking that this paper be carried over until next year, postponing the discussion until the next convention. The paper has far too much important matter in it to be laid on the table, simply read and allowed to drop.

Mr. Bonner : I think it is a very excellent suggestion of Mr. Thompson's that the paper be left over until next year, but I think there are one or two statements made somewhat disparagingly towards steam men. Representing one department of the steam power business, I have just a little to say on these points, but am unable to get actual data so as to place it before the members in an interesting and valuable way. We have not at the present time any data pertaining to Canadian plants which would be of special value to the Association, but it is my hope that during the next six months we will be able to make some tests on one or two complete plants, and if such is the case, I should like very much to present that data in the shape of a paper at the next meeting, and have that considered, perhaps, in connection with this suspended discussion of Mr. Magie's paper.

Mr. Browne : While I appreciate the importance of a very extended discussion of this paper, I fear that the postponement of it for a year may bring us, perhaps, into other phases of the subject, and that the present phase will be practically lost sight of. There are several gentlemen here, I think, abundantly competent to discuss the points thrown out by Mr. Magie's paper, and in order to perhaps provoke discussion and have a little contention on it and brighten the meeting, I may refer to Mr. Bonner's statement that there appear to be some aspersions cast on steam plants. I was conscious during the time of reading that Mr. Magie had been careful to point out that an expenditure on original installation, beyond a certain amount, prohibited competition with steam, and I believe, from what I know of the author and the preparation he gave the paper, that he recognizes the fact that there are many water power installations that should not be installed, because the conditions could be met equally by steam. But there is this one important character about water power transmissions, that, assuming that you are able to serve power during 10 hours a day, from a water fall, at the same price or even a little less than steam, you still have the opportunity of obtaining a revenue from the water power during other times of the day without any additional cost. You cannot obtain that additional profit with steam plant without additional cost, and the

future of the water power transmissions seems to me to be in the direction of the utilization of the power in other hours of the day than the usual ten hours, namely, from 7 a.m. to 6 p.m. I may say that already in the city of Montreal probably the largest commercial enterprise has negotiated for electric power, and has made a change in its hours of operation in order to obtain the advantages and benefits of electric power. If that power had to be produced by steam, they simply could not enjoy the benefits, because they could produce the power for less money. This is an advantage that will develop to a larger extent than now with the power from water falls being used at other times of the day than has been the custom in using steam power.

Mr. A. A. Wright: I do not wish to be known for my much speaking, but I am afraid if I keep on that I will. It seems to me, however, that this paper is a very opportune one, and I may say that the fact of its being read was one of the inducements for my being present. It seems that if there is one subject more than another that is of interest to investors to-day, it is the development and utilization of the numerous water powers which are scattered broadcast throughout the length and breadth of this Dominion. Small towns particularly would be very much improved if the water powers within a reasonable distance could be utilized. There are many points which it is almost impossible to take up and discuss this afternoon. I would like to have it stand over for a year, so that we could have time to study it. I have no doubt that Mr. Magie has spent a great many hours in preparing this paper for us. It covers a great deal of ground and covers it well. I should also like to ask what the paragraph means on page 3, wherein he says, "that when electrically transmitted power does not cost more than \$100 to \$140 per h.p. installed, the investment is apt to be a profitable one, providing, of course, it is properly managed." Does that mean where it costs users \$100 to \$140 per h.p. per annum?

Mr. Magie: That is intended to mean the cost of the installation, including the hydraulic and electric as well as the transmission portion of the plant. Of course, there are many cases where it would be very much higher.

Mr. Wickens: I think that this is a valuable paper, and it is a pity that we did not have it in hand a little earlier. It is too big a question to take up in an off-hand way. There is no doubt there are many points in favor of the use of steam, and perhaps, by leaving the matter open and giving the gentlemen an opportunity to follow these up, we can show some very good results. This Association represents all parts of the Dominion, and there are miles of country that cannot be covered by long distance transmission from water powers. In those places we have to stick to the steam plant, and sometimes we manage to crowd the hydraulic plant very close, simply because it takes a large amount of capital to develop the water power. We have had a few illustrations. Take the Cataract power at Niagara. We know they are selling power in Buffalo, but nobody knows what it is costing. We know they have a great deal of money sunk in the ground, and are selling some current to Buffalo. I know that if we had a good steam plant, properly managed, at Buffalo, we would make money with it, and there are many others too far away from water powers to have this power reach at all, and there are more that have to be carefully managed by the engineer or they would not pay. For these reasons it would be an advantage if the paper was carried over, and thus give the members a chance to go and look into the matter carefully. It would be better to have it thoroughly threshed out, rather than have no discussion at all. I honestly hope that some arrangement will be made by which we can take this matter up at some other time. I hardly see that we can make much out of it at this convention. The balance of our time will be well occupied, but if carried over until the next convention, some of the members could give us some more good ideas on these lines.

Mr. J. J. Wright: I don't exactly understand the carrying over of this discussion till the next convention.

It would be in the province of the gentlemen who would do that to bring in some new facts, but it also appears to me that the men who have been speaking on behalf of the steam plant do not appear to be as sure of the figures in connection with it as the electrical men are. I am quite prepared to endorse one paragraph in Mr. Magie's paper, which is the one referring to direct driven and belt driven plants. I think Mr. Magie has hit the nail on the head in this connection.

Mr. Reesor: I think we should dispose of the paper at this session. Its postponement may lead to accumulation at our next convention. Some questions might be got out of this that might lead to others next year, and perhaps leave it to some other wise head to get up a paper as a growth out of this one.

The President: I think we had better go on discussing the paper.

Mr. Magie: In preparing my paper I did not attempt to fight the steam man, and in fact, tried to give him good lee-way, but merely took up the electrical part of it. If it was wanted to fight the steam man, it would be better to get up another paper.

Mr. J. J. Wright: Most electrical investors won't admit that the steam engine is in the same category as the electric power.

Mr. Thompson: In suggesting that this discussion be carried forward, I do so purely from a desire that it would allow of a proper discussion of the paper. I think we all agree with Mr. Magie when he makes the statement that the use of direct current apparatus for high potential and long distance transmission is out of the question, and we also agree with him when he says the original installation per h.p. of from \$100 to \$140 can be made to pay. In fact, if I were writing the paper, I should have said \$200, and then have stated that it could have been made to pay very easily, but the point arises, why put in 20,000, 30,000 or 40,000 h.p. plants, or, as Mr. Wickens points out at Niagara Falls, with an unlimited power, and then only be able to find customers for one-tenth or less of the output. Too many people imagine, as Mr. Magie has pointed out, that because the water fall, as we have styled it, turns the water wheel the power costs nothing. Mr. McFarlane very aptly illustrated this a short time ago in a little story, which I can hardly repeat in Mr. McFarlane's manner and therefore won't attempt it. The substance of it was this, that in a small town they had lights at a few cents a week, and power did not cost anything, because it was water power. A few years later the dam at the water power had broken down; operation of the plant was discontinued, and the people in the town returned to coal oil, as it was stated that "it cost too much to run water powers." But to come to the point, where large experiments have been attempted, an immense amount of money has been sunk in getting power in advance of the demand. With a city like Montreal I think it advantageous both to the company and to the city, because with the shipping facilities we have in Montreal and the large country to draw from, many manufacturing concerns will be induced to come to Montreal and establish their business so as to get cheap power, but that does not apply in every case. A few years ago I was working a few miles west of Toronto and there was a small town of 4,000 or 5,000 inhabitants wanting to get electric light. There was no way to get it according to advice from electric light companies unless they utilized a water power 10 miles distant. They put in a Thomson-Houston arc machine and endeavored to run from it at the same time both arc and incandescent lights. This was very unsatisfactory, and they then installed an alternating current machine, and still the company is not able to keep its head above water, simply because the cost of installation and keeping transmission lines in repair prevented that company from earning any dividend on their capital, while if they had installed their plant in conjunction with some other manufacturing business in the town, I think it very probable that the shareholders, with the assistance of the steam plant, would have made money. They have been for 15 years increasing their capital and receiving no dividends. This is a case where water

power does not pay. Towards the last of Mr. Magie's paper he speaks of the general utilization of electric motive power in manufacturing establishments. I thoroughly believe in that. In 1895 it was my privilege to take a short holiday and go over the greater part of England. I spent six weeks there, and went into an establishment covering 60 acres, and where as a boy I served my apprenticeship. I remember that at that time there was a great big engine in one corner, with shafting, belting, etc., and I found that every shop in that establishment had now an independent steam engine. The consequence was that the power was only costing them about half what it did fifteen years ago, and this saving was not due to improved engines, but simply to the doing away with a lot of useless power. They can now run any part of the factory independent of the other parts, and I think every engineer will agree that this is the most economical way of running, and one that the shareholders will derive benefit from.

Mr. Reesor: I move a very cordial vote of thanks to Mr. Magie for his interesting paper.

Mr. Kammerer: I would like to second that, and while doing so I want to say to the steam engine and boiler men, that next year, if we go to Hamilton, as I hope we will, we will have a still harder nut for them to crack. Mr. Magie's paper speaks of what we expect to realize there, and I hope in a year from now the Cataract Power Co., of Hamilton, will have realized all that they expect to.

Mr. W. T. Bonner then read his paper entitled, "The Unconscious Ownership of an Important Key." (See page 145.)

DISCUSSION.

Mr. Browne: The title of this paper Mr. Bonner insinuated is a conundrum—to know what this key is. I don't know whether I have got it correctly or not, but I take it to be a suggestion to electric and also to steam roads to employ their rails for the transmission of wagon packages in their original packages, to avoid, besides the long haul by horses and the consequent labor, the cost of loading and unloading, perhaps from the near-by farm to the station, and putting it into a freight car and carting it away. And the unconscious ownership of the key is, that having the road-bed and perhaps the power in the shape of a fully and properly developed water fall, that they would be able to provide additional revenue to the investment, and also make unnecessary the aggregation of people in large cities, because with his proposed scheme the aggregation of population in large cities would not be necessary. People could conveniently live away from towns and large cities and carry on their business; and in this direction I may refer again to the possible changes in our civilization due to a system of this kind with the electric development of water falls. It seems to me the time is not far distant when, instead of gathering together in large cities, by the ability to utilize power in small quantities, requiring the investment of capital to a limited extent, that we may probably change our conditions and become more widespread. Small towns will be able to compete in manufacturing, because so much capital will not be required, and in that way I can see a great deal of advantage in the suggestions thrown out by Mr. Bonner that the production of these small places can be transhipped to places of consumption at very low rates, and in this connection I think his paper deserves a great deal of consideration from the owners of railroads and electrical enterprises.

Mr. Geo. Hill: While there is no doubt that this scheme of Mr. Bonner's is a very interesting one, I think that there is sufficient in it for question. He has struck one of the keys to success of suburban roads. I may say that there are other points of considerable interest that may be brought out by this paper that might be valuable to suburban road owners. His claim is largely to do away with the matter in hand, whatever the section of the country through which the road is to pass has to deal with. Certainly the scheme seems beautiful up to the point where the cart or truck is side-tracked and left there while the wagon is being

taken away and returned. This means the lying idle of a certain amount of the rolling stock of the road, and while another portion of it (allowing that the wagon belongs to the railroad) is in use, nevertheless it is a question whether the former could not more satisfactorily bring his supplies down to a central distributing point opposite his or a number of farms, where it could be gathered up by a moving train at a certain hour, than could be done under the present system. If these wagons were allowed to remain uncovered as they are, the farmer's products would be exposed to the inclemencies of the weather as well as the fact that prowlers might get in at them. Then, again, he loses ownership of the material the moment it leaves the yard in trust of the syndicate. This would not satisfy the farmer, and he never would be satisfied until he followed the goods to market and got the very last cent that there is possible out of it, which as a business man he is entitled to. Now, the railroad company is not going to do this work of commission agent for nothing, and it is questionable whether the farmer wants to pay a commission. I have in my wanderings around the country come across quite a number of suburban roads, and some of them and their schemes are very interesting, noticeably that of the Hamilton, Grimsby & Beamsville road, where they seem to have a very excellent system that appears to be giving first-class results as far as they go. But there appears to be a lack of that broad-mindedness of purpose which we find not only in electric street railroads, but also, I regret to say, in electric light companies. They run through a most fertile country (using the Grimsby road as an illustration), tenanted almost entirely by large fruit-growers and farmers, each of which has a certain amount of power in use almost every hour of the day. They have the grinding of the ensilage product, threshing, pumping, churning, and everything of this nature going on, which requires a certain amount of power all the time, and yet, strange to say, none of these suburban roads seem to be willing to do anything in the way of allowing the farmer to take any power from their circuits. The key to the suburban railroad may be in this, but it seems to me that the suburban railway manager is losing sight of a large field of steady utilization of his power, through not canvassing the farmer and getting hold of that power that is being used all the time. In Manitoba and the Northwest Territories I know of a scheme that went so far that it had very careful attention—and some engineers figured the thing out that the farmer in Manitoba, on the large grain fields there, could, with the straw that they annually burn up in heaps every fall, do all the work of his farm that now requires from 100 to 150 teams, according to the size of the farm, by electric power, by centralising his power in one spot, drawing his straw after the season was over and keeping it in spots where it could be used from time to time; he would have sufficient power to do the farm work and do away with this large number of teams, to say nothing of the men to look after them. I trust you will excuse me; being a city hand I should hardly take the floor in convention, but I would like to say to suburban road managers that I wish to illustrate and throw open some new lines for supplying both power and light.

Mr. Hunt: I would like to ask Mr. Bonner if there is a place in Ohio where the system explained by him is in operation.

Mr. Bonner: These photographs were taken at Toledo, Ohio, where they have already built and are now using this system in an experimental way.

Mr. Hunt: The reason I ask is because I myself and some others have a charter for a road running out of London, and something like this would suit us very well.

Mr. J. J. Wright: I don't believe there is a farmer living who would pay one cent to have any work done that his hired man could do.

Mr. Magie: A large electric light company in Philadelphia is selling a good deal of power to be used for driving small pumps, etc., on farms.

Mr. J. J. Wright: I think in some special cases this might be done, but on the ordinary every day farm of

commerce I don't think an electric plant could be put in to run it.

Mr. Hill : That is the kind of remarks we have been looking for during this convention ; this is a direct challenge of my remarks. I would like to ask Mr. Wright if he knows of any class of people to-day who employ a greater amount of complex machinery than the farmer of to-day, and if at the same time he knows of any class of people who have to deal with more complex methods than the farmer. The farmer to-day, if he was as broad-minded as the individual who would get up and claim he would not pay ten cents if he could get someone else to do it, would certainly not have brought up his farm to any position where it could stand in competition with the large farms that are scientifically run. I know for a fact of a large number of farms around this mountain where much current could be used, running from 15 to 20 h.p., if the managers of the suburban roads would offer their power to them, and if the power could be had it would make no difference to the farmer whether he had to pay for it or pay the hired man to do it.

Mr. A. A. Wright : In the town of Renfrew we have had under contemplation the utilization of a water power which has been lying idle for years, and when we bring that into use we contemplate putting in motors and selling power. Four farmers living quite a distance from the town have made application for power, and have stated that if we would put in the wires they would furnish the poles and put them up and take the power. You must understand that the methods of farming are changing continually. The production of corn is one of the most important, and this has to be cut during the winter, when if they had a motor it would prove very handy to them. If the power could be given to the farmer he would take it, and could use it often.

Mr. C. H. Wright : On the Montreal belt line we have been supplying power to the farmers and have had more demand than we could supply. Our only trouble has been with the insurance people, who object to the "grounding." As regards the supplying of light from our circuit we have been unable to do it, even at our own hotel, where we have had to put in acetylene gas. Another matter in this paper is the transportation of farmers' produce—this can very easily be taken to the city, but when it gets there the farmer wants to look after it himself.

Mr. J. J. Wright : If anyone can give me an instance of any suburban road refusing to sell current, I will take back what I have said.

Representative of the Montreal Park & Island Railway : We have refused to furnish current, although offered a fair price for it.

Mr. Hill : Last March I visited a relative of mine just west of Hamilton, who has rather a nice place, and he told me he was patiently waiting for the Cataract Power Company's pole line to come through his section, because he had been repeatedly to the authorities of the Hamilton, Grimsby and Beamsville road, whose line was not further than a few hundred feet from his place, and although he was prepared to pay them from \$40 to \$50 per horse power per annum, they refused to supply him.

Mr. A. A. Wright : Mr. Leach, a Scotchman and a bachelor, lives about two miles from Renfrew, and has had his house all wired up and offers to put up the poles at his own expense. He has not yet got the light, but perhaps he will.

Mr. Thompson : I heard a gentleman say that the Park & Island Company refused to give power to himself and others, and very justly so. When he went to Mr. Holgate he said what he could give him was not at all what he wanted, for the reason that they are simply running street railway generators, and oftentimes the line opens. Now, what would be the effect of having a motor on a circuit like that ?

Mr. J. J. Wright : As to the Grimsby instance, I think the difficulty is in the price—\$40 to \$50 is not enough for a "farmer's" horse power. I think you will find in the majority of cases the people are not willing to pay a decent price—they have the idea that

this electric power does not cost anything, and they ought to get it for nothing. Why, even in the city of Toronto they are always howling for "cheap power," and if they could, would like to get it for nothing. In cases of friction between purchasers and consumers it is nearly always a case of friction as to cost. People keep telling them that this power will not cost anything, and that the millenium will be here right away, and he thinks he can churn the milk, rock the cradle and pull the cat's tail with electric power. When a man is told he cannot get the current for almost nothing there is a row and a kick.

Mr. Browne : I am reminded by what Mr. Wright says of something that I saw published a short time ago, which goes to emphasize his idea. There is a town in Canada considering the putting in of an electric plant to be driven by water power, and they have actually advertised that they will have power for sale in units of 30 h.p. and up, as low as \$15 per horse power. If the project be carried through, and they be able to sell at \$15 per h.p., it would seem to me to be very unwise for that town to undertake to transmit that current for 16 or 17 miles, when they could pick up the farmers before they got to the end of the 17 miles and make more money. I think the difficulty with railroads in seeking this market heretofore is that they have been built to meet the first demands, and have grown slowly, and have not therefore had the power to spare, because there are peak hours of the day for railroads, when the demand is more than they can supply, and they are not in a position to say to the farmer that at that time he can use the power. But electricity is only in its infancy, and, as Mr. Wright says, people are crying for electric current although some still cling to the tallow candle. The progress is onward, and the day is not very far off when all the farmers will be operating their farms, rocking their cradles, churning the milk and pulling their cat's tail by means of electric current.

Mr. Hill : I move a vote of thanks to the gentleman who gave us this paper, which has afforded such a pleasant discussion.

Mr. Ellis : I second the motion.

The President : Mr. Bonner, I wish to thank you for the interesting way in which you have prepared this paper, and also Mr. Browne for his clear explanation as to the meaning of the unconscious ownership of the key referred to.

Mr. Bonner : I would like to make one or two suggestions with regard to the doubt expressed by Mr. Hill of the farmer trusting his produce into the hands of the railroad company. As is stated on page 6 of the paper, the wagons will be tarpaulin covered at all times, whether loaded or not. Now, it is just as feasible to protect the goods in that way as any other, as they are transported on the English roads in this manner right along ; in fact, I don't think I saw any box cars on the other side, and there is ample protection given to the goods by the tarpaulin cover referred to, which is attached by a chain running through eyelets on the edge of the tarpaulin and connected to the sides of the cart, so that it can be locked or sealed just as securely as if the shipment was in a box car. As to the farmer being unwilling to let his goods go out of his possession until they are turned over to the purchaser and he gets his money, I think this is largely a question of education ; and as to the question of cost, I understand it to be one of the claims made by the rail wagon company, that they can effect this transportation cheaper by doing away entirely with the re-loading. In that way they will reduce the net cost of transportation from the farm to the consumer, and I believe that eventually this will be recognized as a fact.

The meeting was then adjourned until the following day.

SECOND DAY.

The President called on the Secretary-Treasurer to read his report for the year ending May 31st, 1898, which was as follows :

SECRETARY-TREASURER'S REPORT.

MR. PRESIDENT AND GENTLEMEN :

I have the honor to submit for your information and considera-

tion the following particulars regarding the work of the Association for the year ending May 31st last, together with a statement showing the present standing of the membership and finances.

The Executive Committee have held five meetings since last convention. At the first of these held on June 29th, 1897, accounts amounting to \$360.22 were passed for payment. Messrs. Kammerer and Armstrong were appointed a committee to learn what transportation rates could be secured for this convention.

At a meeting on September 7th these gentlemen reported that the railway authorities had promised to take the matter up after the first of the new year. A Committee on Transportation was then appointed, consisting of Messrs. J. A. Kammerer, C. B. Hunt, J. J. Wright, Wilfred Phillips and F. C. Armstrong. Messrs. C. B. Hunt, A. M. Bowman, A. A. Dion, J. J. Wright, A. M. Wickens, W. H. Browne and the Secretary were appointed a Committee on Papers. The following gentlemen were appointed a Committee on Arrangements, with power to add to their number and appoint sub-committees: Messrs. Wm. Thompson, W. H. Browne, John Carroll, L. B. McFarlane, F. H. Badger, jr., J. A. Baylis and O. Higman. The Secretary was instructed to render accounts to members in arrears for fees and make drafts if amounts were not paid within a reasonable time.

On April 5th, 1898, the Committee on Papers reported that offers of several papers had been received. It was decided that the completion of arrangements for papers should be left in the hands of the Secretary. Mr. Browne was authorized to engage a local stenographer to report verbatim the proceedings of this convention. Owing to Mr. Kammerer's illness Mr. Browne was appointed chairman of the Committee on Transportation. The dates recommended by the Committee on Arrangements were adopted for the present convention, and the sum of \$150 was appropriated to the committee for entertainment purposes. The draft programme for the convention submitted by the committee was adopted with slight amendments.

At the meeting on May 25th nine persons were elected to membership and the resignations of ten members accepted. Mr. Kammerer and the Secretary were appointed a committee to obtain designs and estimates of cost for an Association button to take the place of the badges worn by members at previous conventions. The Secretary was directed to write members who had failed to pay the drafts made on them for arrears of fees that unless payment should be made prior to June 10th their names would be dropped from the membership roll.

In the early part of this year a pamphlet setting forth the character and purposes of the Association was prepared and printed under the direction of the Executive. About eight hundred copies of this pamphlet have been judiciously distributed.

Particulars of the important work which has engaged the attention of the Legislation Committee will be laid before the Association in the report which the committee will present at this meeting.

In view of the unusually full programme of events, it was deemed advisable to reduce the number of papers to be presented at this convention, but they are believed to be of a standard which entitles them to careful consideration and discussion, and places the Association under obligation to the kindness of the authors.

Incidental reference may be made to the recent formation of the Maritime Electrical Association (of which Mr. Bowman, a member of the Executive of this Association and author of one of the valuable papers on the programme of this meeting, is the president) to conserve and promote electrical interests in the provinces of Nova Scotia and New Brunswick.

During last year death again entered the ranks of our members, and we are called on to deplore the loss of Mr. Ross McKenzie, of Toronto, and Mr. Chas. Ernst, of Detroit.

During the year there was dropped from the roll the names of 21 members, 12 active and 3 associate members having resigned, 2 having died and 4 having changed their place of residence and having neglected to furnish their new addresses to the Secretary. Since the 1st inst. two additional resignations have been received, and the names of 13 members have been struck off the roll for non-payment of fees. Thus there have been removed from the membership list between last convention and this 36 names. During the same period there were added 68 active and 11 associate members—a total of 79—leaving the present total membership 234.

Following is a detailed statement of the receipts and disbursements for the year:

FINANCIAL REPORT FROM JUNE 1ST, 1897, TO 31ST MAY, 1898.

RECEIPTS.

Cash in bank, June 1st, 1897.....	\$410.57
Cash on hand, June 1st, 1897.....	5.25
111 active members' fees at \$3.00.....	333.00
1 active member's fee at \$3.00—paid.....	2.00
20 associate members' fees at \$2.00.....	40.00
	\$790.82

DISBURSEMENTS.

Expenses of convention.....	\$351.77
S. Barnett's account.....	\$150.00
W. Phillips, band and floral decorations.....	34.00
Transportation B. and N. F. electric railway....	12.00
Hotel Lafayette (cartage and express charges)...	1.25
Blackhall & Co. (100 certificate covers).....	8.00
Alexander & Cable (lithographing badges).....	5.00
George Angus, stenographer.....	25.00
Electrical News, printing.....	111.79
Pins and ribbon for badges.....	3.18
Express charges.....	1.30
Telegrams.....	.25
	\$351.77

Grant to Secretary.....	75.00
Electrical News, printing account.....	24.00
Stationary and carbon paper.....	5.55
Printing 150 certificates for members.....	1.25
Exchange on cheques and drafts.....	7.20
Express charges.....	.64
Postage.....	24.77
Cash in bank, May 31st, 1898.....	281.18
Cash on hand.....	19.46
	\$790.82

RECEIPTS SINCE MAY 31ST, 1898.

Cash on hand, June 1st, 1898.....	\$ 19.46
46 active members' fees at \$3.00.....	138.00
1 active member's fee for one year and eight months.....	5.00
5 associate members' fees at \$2.00.....	10.00
	\$172.46

EXPENDITURE.

Postage.....	22.65
Exchange on cheques.....	1.10
Receipt forms.....	.30
Telegrams.....	1.43
Express and duty.....	.41
	\$ 25.89
Cash deposited in bank since June 1st, 1898....	113.00
Cash on hand June 25th, 1898.....	33.57
	\$172.46
Total standing to credit of Association, June 25th, 1898.....	\$427.75
Receipts since June 25th.....	\$161.00
Total at credit of Association, June 29.....	588.75

On motion of Mr. Barrie, seconded by Mr. Breithaupt, the report was adopted.

The next item of business was the consideration of the reports of committees. The President advised that the only one that had been written out was the report of the Committee on Legislation, of which he was the chairman, and which was as follows:

REPORT OF COMMITTEE ON LEGISLATION.

Your Committee beg leave to report that in pursuance of the motion passed at the last Convention held at Niagara Falls, instructing your Committee to take up the matter of securing legislation in connection with the movement among municipalities in Ontario to enter upon electric light undertakings, in unfair competition with companies already in existence, your Committee held their first meeting at the close of the Convention. At that meeting it was decided to procure an opinion from Donald Guthrie, Q. C., ex-M.P.P., of Guelph, and to retain him professionally on behalf of the Electrical Association in connection with the question.

Various questions were submitted to Mr. Guthrie, and his opinion in answer to these questions was considered at a meeting of your Committee held in Toronto on the 9th of November. A copy of the opinion is attached to this report.

We also had a communication from him, giving his views as to the prospects of securing favorable legislation at the last session of the Legislative Assembly. After full discussion your Committee decided to give instructions for the preparation of a short bill to be submitted to the House, which would at least afford some measure of relief to those companies that were immediately threatened with unjust municipal competition.

Another meeting of your Committee was held in Toronto on the 10th of December, when the solicitor was present, and after considering the whole situation fully and carefully, instructions were given for further proceedings.

With that view a bill was prepared which came before the Municipal Committee of the Legislative Assembly on the 12th of January. Your Committee, in preparation for the meeting, assembled in Toronto on the 11th and also on the 12th, and attended the meeting of the Municipal Committee for the purpose of supporting the bill. The Committee had also the assistance of Mr. Lash, Q.C., with Mr. Guthrie.

After discussion those representing us consented to a suggestion of the Honorable Mr. Hardy, Chairman of the Municipal Committee, and other members of that Committee, to allow the matter to stand over for another year. The discussion, however, brought out the fact that there was really no sound answer to the principle of the proposed measure. It also evoked an expression of opinion from the leading men of both political parties to the effect that the underlying principle of the bill was just. The Municipal Committee thought that there was not proper time to consider how the bill would affect places where there were more than one existing plant, also places that derived or may derive power from points outside the municipality, also to consider the length of the life of an electric plant and other questions, and in the judgment of the Municipal Committee any bill dealing with the matter would require more ample public discussion and some modification. The action of your Committee and the discussion the question has received has tended to bring into prominence the injustice of the present law. The necessity and propriety of some measure of relief may be considered now to be more generally admitted. The work thus inaugurated and which has attained a hopeful position, should not be discontinued.

The present law of Ontario is inequitable towards lighting and power companies, because it permits a municipality, after it has given its sanction to the formation of such a company and has encouraged enterprising citizens to embark their capital in it for the purpose of supplying the municipality with light and power, to turn around and destroy, with public funds, and without public necessity or advantage, the value of the property of those citizens who were encouraged to invest their private means in the enterprise. What evidently struck the majority of the members of the Municipal Committee was that the proposed legislation was just and equitable because, while it did not prevent municipalities entering upon municipal supply of lighting if they so desired, it made provision for extending the existing law regarding water works to the case of lighting companies. This law is to the effect that where a municipality desires to supply water and there is an existing water company incorporated for the municipality, the council shall not levy any water rate until the council has, by by-law, fixed a price to offer for the works or stock of the company, nor until after thirty days have elapsed after notice of such price has been communicated to the company, without the company having accepted the same or having, under the provisions of the Municipal Act as to arbitrations, named and given notice of an arbitrator to determine the price, nor until the price accepted or awarded has been paid or has been secured to the satisfaction of the company; the price to be determined by arbitration under the provisions of the Municipal Act.

It will be observed that this provision in no way interferes with municipalities going into the supply of water. It simply provides that if they do enter upon such undertaking they are by this law bound first to try to buy at a fair price, or at a price to be fixed by arbitration, existing waterworks. No good reason can be advanced why this law should not be extended to lighting and power companies as well as to waterworks. It is eminently just, and it imposes no hardships on the municipalities; nay, rather, it benefits them, because it tends to extinguish rivalry to themselves, which rivalry might render municipal operation of these works unprofitable, and at all events it puts them in possession, at a fair valuation, of the very plant and material that they would have to purchase from other people if they are going into the business. The proposed legislation is in the public interest, because it will further encourage private citizens to invest their capital in extending and improving existing lighting and power works.

It was generally acknowledged by the Municipal Committee that electric light companies as well as water companies have always come into existence with the consent, encouragement and approval of the municipality, which has granted the use of the streets, etc., for these works.

The last meeting of your Committee was held in Toronto on February 3rd, for the purpose of passing accounts. At this meeting, accounts for legal services, printing, stationary, postage, exchange on drafts and office assistance, amounting to \$622.56, were ordered to be paid. The funds to meet this amount were contributed by the following companies: Brockville, St. Thomas, London, Ottawa, Waterloo, Brantford, Carlton Place, Guelph, Lindsay, Galt, Barrie, Owen Sound, Cornwall, Strathroy and Cobourg Gas Company, in amounts ranging from \$150 to \$100. It will be observed that while there are about two hundred lighting companies (who were all invited to assist) carrying on business in the province of Ontario, all more or less interested in having legislation secured to protect their capital from confiscation, only fifteen of that number contributed to the expense fund of your Committee. We are pleased, however, to say that through the liberality of these companies all claims are paid. It is quite evident to your Committee that if the work in hand is to be carried to a successful issue, a more general, liberal and hearty support will have to be accorded them. It ought to be mentioned here that all the members of your Committee paid their own travelling and other expenses in connection with attending the meetings. The movement amongst municipal corporations to enter into the lighting and power business in competition with those who had the courage to be pioneers is growing, and unless regulated in some way by the legislature, will result in the confiscation of a large amount of capital invested in the business, as witness the town of Barrie now preparing to put in a complete plant, including arc, incandescent and power services, to be paid for out of public funds, for the purpose of competing with and destroying the Barrie Company, a private and lawful enterprise.

Your Committee desire to mention that Mr. Pepler, Q.C., of Barrie, and Mr. Farley, Q.C., of St. Thomas, two of the members of your Committee, rendered valuable services in connection with the promoting of the bill referred to.

Dated 14th June, 1898.

JOHN YULE,
Chairman of Legislation Committee.

GUELPH, 4th November, 1897.

JOHN YULE, Esq.,
President Canadian Electrical Association, Guelph.

DEAR SIR,—In answer to the questions submitted by you for my opinion, I have to say:

By the statutes now in force in Ontario touching the acquisition of gas and electric works by municipalities, municipal corporations have the power: (1) To erect gas and electric works and operate the same in opposition to an existing gas and electric light company, without the consent of that company and without attempting to negotiate with that company either for the supply of light or for the purchase of their works, and this notwithstanding the fact that the company might have been organized and carried on with the express sanction of the municipal council. (2) Municipal councils have also power to acquire the rights of a

gas company incorporated on and after the tenth of March, 1882, at a valuation, that is to say, they have power to expropriate the property, and they, of course, also have power to acquire it by agreement with the company. (3) On the other hand, it appears that a gas company or an electric light company has no power to prevent a municipality entering into competition with them in the case of gas and electric works or to do anything which shall compel the municipality to purchase their works at a fair valuation.

In regard to the powers of a municipality to construct water works, there seems to be a restriction which does not exist in the case of gas and electric light works, for, by section 507 of the Consolidated Municipal Act (1892), it is provided that in case there is any water company incorporated for the municipality, the council shall not levy any water rate until such council has, by by-law, fixed a price to offer for the works or stock of the company, nor until after thirty days have elapsed after notice of such price has been communicated to the company, without the company having accepted the same or having, under the provisions of that act as to arbitrations, named and given notice of an arbitrator to determine the price, nor until the price accepted or awarded has been paid or has been secured to the satisfaction of the company. By 60 Vic. (897) Chap. 17, Schedule C 88, it is further provided that the price shall be determined by arbitration under the provisions of the Municipal Act.

It seems to me that an amendment to section 507 should be sought, making it to read that in case there is any gas company or electric light company or water company incorporated or existing in the municipality, the council shall not levy any rate for the construction of gas or electric light or waterworks until the council has, by by-law, fixed a price to offer for the works or stock of the company, etc. That would place gas and electric light companies on the same footing with water companies.

There is no just or sound reason why Parliament should refuse an amendment to the Municipal Act to give gas companies and electric light companies the same protection as water companies, against municipal interference with an existing business, and subject to provisions for an arbitration. I think such an amendment would be likely to carry. It couldn't be said that its effect would be to prevent municipalities from embarking in municipal lighting. They would still retain full power to do so; but to do so with the plant and works of an existing company, to be first acquired on fair terms.

In case a point was made in this connection, that municipalities should have the power of erecting their own lighting plants without being compelled to purchase the commercial part of a plant of a gas or electric light company, provision could be made for such a case by an enactment compelling a gas or electric light company to sell the part of their works connected with public lighting in case the Lieutenant-Governor-in-Council, or arbitrators to be named by him, considered they ought to be compelled to sell the same to a municipality without requiring the municipality to purchase the part of the works of the company connected with commercial lighting.

In order to secure an impartial judicial investigation and decision on the important questions involved, I suggest that the arbitrators, under all the amendments herein suggested, should be three county judges to be named by the Lieutenant-Governor-in-Council, they to determine as to right to purchase and the extent and price and terms and conditions of purchase.

I may also suggest for your consideration, whether it would not be expedient to consent to a provision for an arbitration to fix the rate for public street lighting which a municipality should pay to an existing company in case the municipality and the company differed. In that case a municipality would be deprived of an excuse for going into gas or electric lighting on its own account.

In England local, in other words, municipal authorities, are only authorized to supply gas for public and private purposes throughout the whole or any part of their district where there is not any company or person authorized by or in pursuance of any act of Parliament or any order confirmed by Parliament to supply gas for public and private purposes, and where such company or person do not supply gas within any part of the district covered by the local authority, and if there is any such company or person so supplying gas, but the limits of supply of such company or person include only part of the district, then the local authority may themselves undertake to supply gas throughout any part of the district not included within such limits of supply, but even then before the local authority may, under the act, themselves undertake to supply gas for the whole or any part of their district, they must obtain a provisional order authorizing a gas undertaking under and subject to the "Gas and Waterworks Facilities Act, 1890"; that is, they have to obtain authority from what, in England, is known as the Local Government Board, which has been, for the purpose of that act, substituted for the Board of Trade. There is also in England provision giving gas companies power to sell their works to local authorities, that is, by mutual agreement.

The law in Scotland is regulated by the Burghs Gas Supply (Scotland) Act, 1876, but the first provision of that act limits its application so that Burghs have no power to supply gas within any part of the area of supply over which any gas company incorporated by Act of Parliament or any co-partnership or person authorized by any provisional order confirmed by Act of Parliament, shall have statutory powers to supply gas at the date of the adoption of the Act in the Burgh.

The Commissioners, under this Scotch Act, for the Borough, however, are authorized to buy from gas companies (that is, by mutual agreement) their works; but there is also a special provision to which I desire to call your attention: Section 21 of the Act, that "Where there is a company not incorporated by Act of

Parliament or authorized by provisional order confirmed by Act of Parliament supplying gas within a Borough, the Commissioners, before they shall exercise any of the powers conferred by this Act, shall give notice to such company that they are willing to buy or to treat for the purchase of the undertaking of the company and of all the rights, powers and privileges and all the lands, premises, works and other property of the company, and if such company shall consent in manner provided by the last preceding section, to sell the same, the commissioners shall purchase the undertaking on terms mutually agreed upon or to be fixed by arbitration in the manner provided by the lands 'Clauses Consolidated (Scotland) Act 1845' respecting matters thereby directed to be settled by arbitration, and if such company shall refuse to sell the same, or shall not within two calendar months after the service of such notice return any answer, the Commissioners may present a petition to the sheriff stating the facts, and the sheriff shall, on being satisfied by evidence of the facts as stated, discern accordingly, and on such decree being announced, the Commissioners shall have and may exercise all the powers conferred by this Act"; a clause which seems to me to be substantially in its operation the same as our enactment, section 507 of the Consolidated Municipal Act with regard to water companies.

As quoted in your annual address to the Canadian Electrical Association in June last, section 27 of the British Electric Lighting Act, 1882, provides that where an electric light company is established the local authority or municipality cannot interfere with it until the expiration of twenty-one years or such shorter period as is specified in the application for the provisional order or in the special act, etc. At the end of twenty-one years the municipal authorities may, by notice in writing, require the electric light company to sell their undertaking upon terms specified; if they do not so require, then the company goes on for seven years further; at the end of that seven years the municipal authorities have again a right to purchase, and so on at the end of every seven years. Then it has to be observed that the terms of purchase include not only the value of the lands and works, but also, where part only of the undertaking is purchased, provision must be made for loss occasioned by severance.

With regard to the law in the United States, it is said in a work of Crosswell on the law relating to electricity: "If an electric light company exists in a town, and has been granted by the town certain rights to set its poles and string its wires over the city, yet if this right is not exclusive in terms the city violates no contract or debt towards the electric lighting company by purchasing its own (i.e., a rival) electric lighting plant and engaging in the electric light business. To avoid, however, the practical injustice of such a course, the statutes which authorize municipalities to engage in the electric lighting business generally provide in some way or other for the purchase by the municipality of any existing electric light plant at prices fixed by the commissioners in case of disagreement."

The same work states that in Iowa, Massachusetts, Michigan, Nebraska, Ohio and Pennsylvania, statutes have been passed regulating the subject of the operation of electric light plants by municipalities.

I would suggest that your general committee appoint an executive committee to attend to the whole subject of promoting and securing the necessary legislation, and that a short agreement be got from those gas and electric light companies who are willing to contribute towards the expense, in some such form as I now send.

Yours truly,
(Signed) DON. GUTHRIE.

Extract from Mr. Guthrie's opinion to Mr. Yule, President Canadian Electrical Association, 4th November, 1897:

"I therefore recommend that an amendment or amendments, as here indicated, be applied for, and that your Committee on Legislation should take the usual steps in such cases to promote the passing of the measure. This would include interviewing the leading members of Parliament, both on the Government and opposite side of the House; the circulation of printed matter, securing favorable articles in the leading newspapers, so far as possible; having the officers of the various lighting companies throughout the province interview their local members and secure their support as far as possible to the measure; also by counsel and otherwise to support the proposal when it comes before the municipal or other committee of the House to whom such bills are referred, and by other legitimate means have the adoption of the necessary amendment secured."

Mr. J. J. Wright moved that the report be received and the committee continued.

Mr. Hunt: In regard to this report, I think it has gone into the question so thoroughly that it has left nothing for the committee to add to it. I would like if some of the members, who are not on the committee, would express their opinion as to whether they approve of it or can devise some better way of handling the matter. I think some of the members who are not so conversant with it as the committee might give us their opinion.

Mr. Noxon: Those who were at the convention a year ago will probably remember the discussion which took place upon this subject of the adoption of municipal plants by municipalities before they were justified. I stated at that time that I was not directly interested in that question, having foreseen when entering into the

electric light business a probability that a plant instituted by private enterprise might become worthless by competition from a municipal plant, but I am in thorough sympathy with those who have such opposition and may have their plant depreciate, and I think it only right that every effort should be made by those in the business to remedy such a state of affairs. I notice in reading over this paper that they have a law in Great Britain—Scotland I believe—such as we are seeking to obtain. This is one of the strongest points the Association can make, as throughout Canada and all English speaking countries the English law has been taken as a precedent, and I therefore have greater hope of accomplishing what we desire in that direction, because in addition to the justice of the position, the fact of a law having been passed in Britain, where they have had more experience probably than we have had in this country, should influence our legislators. I see it is said in this report that it is nothing more than just and right that a municipality should, before embarking in opposition to a private enterprise, be first compelled to take the position of coming to an amicable settlement covering the purchase of the existing plant. I see, however, that a parallel is drawn with the Water Works Act. It is quite possible that those who are promoting this directly and having to do with the legislators, will have the objection made that whereas a waterworks plant is one of permanency, not only in the nature of its construction but also in its general principles, it may not be considered, as a lawyer would say, "on all fours" with an electric light plant, which is liable to a great many changes necessitated by the constant improvements and inventions in the art. It might be said that the electric light plant might become obsolete by reason of later improvements and inventions, whereas a waterworks plant is not likely to be subject to that condition. I don't think, however, this would be a very important contention, because the law would fix the value of the plant as relating to the modern methods of construction and operation, and for that reason there would be no objection or injustice in insisting that whatever the nature of the plant might be, the municipality should be compelled to take it over at its value, considering the special features in the case; and I do not see that this Association can be accused of anything in the way of selfishness in endeavoring to legislate with that purpose and end. We will, of course, as an Association and as members, look at this matter from the other side as well as our own, as nothing can be gained by looking at anything from only a selfish standpoint. You cannot expect your ideas to prevail unless they will commend themselves to those whom you wish to convince, and for that reason we must look at the matter from other points of view. We have endeavored to do that, and I can see no reason whatever why the municipalities should not accept this, and why the government could not provide this legislation. I think the convention is perfectly justified in using its utmost endeavors and influence to bring this legislation about, and I believe that if this is done, by united efforts the legislation can be procured.

Mr. Breithaupt: I am not conservant with this subject, this being the first convention I have attended. I cannot, therefore, say much on the subject. As already brought out, the point of precedent having been set in England and Scotland seems to me to be about the strongest argument aside from the proposed legislation being just for both parties. If it is just for waterworks to have such legislation, why is it not equally just for gas and electric light companies? Taking the three on a par, I don't see why the municipalities should raise great objections, because they can, at any time, have an arbitration before purchasing the plant, and they would not, I presume, expect to pay for the plant less than its par value. In the United States, as is also brought out in the report, there is a similar act which also assists and helps to encourage the individual, corporation, gas and electric light companies. All of these facts together should certainly help the Association in getting this desired legislation. There is another point which certainly needs to be emphasized, and that is that those of us who are central station

managers will certainly have to support the legislation, not only by speaking for it, but also financially. I realize that very clearly. There is a great deal of expense connected with it, and I think we all should do our part in helping to bear this expense. There are a few towns in the west who have had this question brought before them in a very emphatic manner. In our own town they still have some five weeks to decide whether they will bring the matter of lighting to vote, put in a plant, or give the present company a contract for a number of years. A lighting company in a neighboring town, whose manager is also present, have found a good deal more difficulty than we have, and they have the question brought even more emphatically before them than we have. The point brought out by Mr. Wright as to keeping on friendly terms with the members of the town council is a very good one. We endeavor to be so much as possible, and if we cannot secure this legislation, we can at least continue supplying the town with light and power. I would very much like to see this legislation secured during the present year, and the various companies receive the protection that is really due them.

Mr. Ellis : I don't know that I can add anything to that which has already been said. I may tell you a little about our experience in Barrie. We have been for two years without a contract from the town. We have approached them in every imaginable way, and they simply say, "We don't intend to talk to you at all." About three weeks ago I wrote, asking if they intended renewing the contract, that we were anxious and willing to negotiate with them on a fair and reasonable basis, and put in another clause saying that if the town really desired to go into the electric lighting business, we would sell our plant at its value. In reply they wrote us to put in a tender, and, in fact, advertised broadcast for tenders, and asked to have ours put in with the rest. We thought it was unfair to bring us in competition with the manufacturer, as we had a plant that had cost a great deal of money, and no doubt more than it was worth to-day. We had established a business and built pole lines in all parts of the town. We wrote them to that effect, suggesting that we would be willing to have the value of our plant fixed by appraisement, they selecting one representative, we the other, and these two to select a third. But they would not listen to this at all. I know our Mayor has corresponded with the heads of municipalities regarding this matter to get their experience. We are going to have some very strong opposition. I think it is becoming of this Association that we start right in now, and not only talk about this legislation, but interest the members in our constituencies, and put every argument before them, so that they can see we are only asking what is just and right.

Mr. Noxon : I would like to suggest the advisability of discussing the question of the separation, in case of the purchase of the plant by municipalities, of the municipal and private service. In the event of separation I see a great deal of difficulty in the municipality buying only a portion of the plant. The report says it could be separated. I don't see how. It would practically mean the doing away of the private business of the company unless they put in a separate plant, and this, I think, complicates the matter very much and is a very important factor in the disposal of these plants in the event of purchase by municipalities.

The President : I have followed this matter closely, and am glad that others have spoken in the way they did, not only on the report, but on the financial aspect of the case, because my experience has been that the majority of people are always anxious to reap where others have sown. They give all sorts of promises, but when it comes to the point they are not there. What was impressed upon your committee at the last meeting of the legislature, was that these things have to be fairly and squarely met, and have also to be freely discussed. The committee of the legislature did not feel inclined to go on with the bill last session. The House was called two months earlier than usual, and being the last session of the House, members were not disposed to

commit themselves. In place of submitting the regular bill a short bill was introduced that would give relief until the larger bill could be put through, and it was understood that if there was any opposition, the members should not be asked to commit themselves in any way. There are different ways of looking at the thing. One eminent counsel was so impressed with the fairness and justice of the proposed legislation that he said he would not be afraid to go into any constituency and defend the vote of any member. This gentleman went over to the great majority a few days ago—the late Mr. Dalton McCarthy. The ground was broken, however, and we have made, I think, very good progress. Hon. Mr. Hardy made the remark to us as we went out, that he had no doubt that in any question of this kind that might come up in the province during the year, the municipalities would be willing to submit the matter to arbitration, but we find in Barrie that they will not negotiate in any way. I have good hopes of getting a certain amount of protection from the legislature if gone about in the proper spirit and the arguments made in a fair and business like way, and I am sure the work done during the year will bear fruit and help us very considerably.

Mr. J. J. Wright : I think the strongest prominence should be given to the fact that when the plant is purchased by arbitration, it is purchased at its value. Every plant has its value, and the municipalities would only be asked to purchase the plant at its value, which would be the same to the municipality as to the lighting company. I think if that point were given greater prominence that a good deal of the objection would be disposed of. There is another serious objection, that is, the dividing of the two branches of private and commercial lighting. Now, if in some town a small plant was operating commercial and private lighting and the municipality desired to purchase only that part of the plant that they wanted, it would simply mean ruination for the company. The investment of the company would be practically destroyed, because it would leave them with a small dynamo or proportion of one that was used in the supply of commercial lights. This is a question that should be impressed upon the committee, so that they may give that point particular attention.

The President : I think in the English Electric Lighting Act they have a provision for severance.

Mr. J. J. Wright : I think if you go to the legislature and ask that the municipalities should be compelled to purchase the business of a going concern with the good will of the electric light business and the franchise of it, you will not have much success. The only way is to get the municipality to arbitrate and take over the whole business at its value. I know a great many people who, in considering this question, have the idea that it is poor policy for a municipality to go into commercial business, especially electric lighting and power. Why should the municipality go into the business of supplying power to a few users when the socialistic problems of municipal affairs are of much greater importance? For instance, they could go into the coal business, which is a necessity, and let the people have coal at cost prices; also the supplying of bread and other necessities.

Mr. Ellis : Is there a precedent in Canada of any municipality entering into opposition with any company for commercial and street lighting? I ask this because I was reading an article not long ago, which gave the opinion of the Chief Justice of the United States. This matter had been brought up in the courts, and he gave the decision that the demands of the people made it necessary to establish such enterprise, and municipalities encouraged private citizens to invest their money therein, and he said that while it might not be giving them a perpetual franchise, it was in reality the same thing, and he said that that kind of confiscation of the people's money should not be tolerated, and the law must step in and protect the investors.

The President : You will all doubtless remember that some time ago in Toronto, Baron McDonald proposed that the charter of the Street Railway Co. there be cancelled, and the mayor very quickly stepped in with a

report and pointed out the unfairness of cancelling the charter of a company in which the innocent shareholders had placed their money, and that he was, therefore, not in sympathy with it. Why should they do this thing to electric light companies?

Mr. J. J. Wright: I cannot understand why the electric light industry should be singled out as an object of attack by the municipalities.

Mr. A. A. Wright: They think there is a lot of money in it.

Mr. Ellis: I had occasion, as Mr. Smith knows, to go into the court business myself, against one or two of the strongest corporations of Canada, and Justice Rose ruled against me on this account, that the corporation had invested a lot of money and had established a business, and it was not fair for me to go in there and demoralize their business, and he thus gave his decision against me. There was no precedent for it. I think perhaps if I had had the matter brought to the higher courts in Canada they would not have decided in our favor.

The President: From Messrs. McCarthy's and Guthrie's opinions it is very clear that the municipalities have the right to go into competition with the local company.

Mr. W. A. Johnson: There are both commercial and street lighting systems used in St. Marys, where the corporation have put in a street lighting plant and have not gone into the private lighting.

Mr. Breithaupt: The point was brought up why the lighting companies were attacked. I think it is just because of the popular vote, and that is why there is always such a howl made about lighting contracts before election—in order to get the vote.

The President: Another idea that some municipalities have is that if a dynamo is set alongside their water works it will light their streets for nothing.

Mr. Ellis: In connection with the Barrie waterworks they have two steam pumps, and two-thirds of the people of Barrie think, and some of the Council lead them to believe, that all they have to do is to hitch a dynamo to the pumps and they can run their street lights.

Mr. J. J. Wright: Why, that is what they think in Toronto.

Mr. Noxon: The question might arise as to how far the electrical supply men are responsible for this idea of municipal lighting. It occurred to me that if the supply men would not encourage municipalities in this thing, it would go a long way towards getting rid of the difficulty. I think it would be only just to ask that the supply men do not do any more than is necessary to encourage municipalities to put in plants of their own—not refuse to give them figures, but protect the legitimate trade by not giving inside information or prices.

Mr. Johnson: On behalf of the supply men, I wish to say that quite recently it was proposed to put a plant in a small town. Elaborate specifications were prepared by the engineers, but they had not any by-law authorizing the purchase of the plant or any money to pay for it. Certain of the supply men got together to consult about the advisability of offering some agreement that no manufacturing company should tender unless the municipality had fully decided to purchase a plant and had made arrangements concerning the funds necessary to pay for it. I think the feeling among the manufacturing companies was that it was a very desirable arrangement if it could be fixed in a workable manner. I might say that within three or four days after the suggestion to make such arrangement, the town councillors and pretty nearly everybody else had heard about it, which, of course, made it impossible to carry the proposition through.

Mr. Ellis: When tenders were called for in Barrie, they were to close on the 6th day of June. About the 5th or 6th they had very few tenders, and an untrue and malicious report was circulated broadcast that we had bought up all the supply men and manufacturers in the country; so they sent their engineers to nearly every place in Canada where they were manufacturing, and I understand they now have a bag full of tenders. In our case I think the supply men

have not shown any tendency to encourage municipal ownership.

Mr. Hill: I trust the proprietors of electric light installations do not look upon the supply men as their enemies. I am sure if they look at them in the light they ought to, that the relations between them would be much improved. Take the question of the installation just spoken of. The gentleman said that it was imagined by those interested that this expert of theirs had bought up all the electrical people in the country, or possibly they had bought him up, but I think it would be necessary for him to do the former in order for him to carry out the specifications in the first place, as in order to carry out these specifications they would be doing an injustice to themselves and the town, and as such the result Mr. Johnson spoke about was brought about. The electrical supply men of Canada are working for the prosperity of the electrical people as a whole. We have brought out nine-tenths of the improvements in apparatus and supplies, from the incandescent lamp back to the dynamo; we are bound up in your interests, and any set-back that the electrical fraternity receive, either in a large or small degree, would be a set-back to ourselves, and I can assure you, from my experience of the supply dealers of Canada, that for you to imagine that we are going to cater to a trade that would hurt the electrical fraternity, would be a mistake.

The President: In regard to the supply men, we know who are our friends and who are our foes. We know a great deal more than they give us credit for sometimes.

Mr. J. J. Wright: That is all right, but there is another class doing more harm than the supply men, and that is a certain class of half-baked people, such as dynamo tenders and supply men, who pose as electrical engineers, and when they are fired out of some reputable concerns in the country, they go around stirring up lies.

Mr. Bowler: There are some people that that remark might hit pretty hard. I am running a municipal plant. I think Mr. Wright should name the parties to whom he refers.

The President: I don't deny for a moment that any municipality has a perfect right to go into the lighting business if they wish.

Mr. Browne: I believe, however, that it is not admitted that an electric light station already installed in a town or city can be attacked by the municipality investing in a plant to compete with it.

Mr. Reesor: I would like to draw your attention to this fact, that according to the Ontario Statutes municipalities, when they donate a bonus to any manufacturing concern coming to their town, must not interfere with existing interests of the same class of manufacturers. Now, the municipality, in putting in a new plant to do its lighting, is really using the taxes contributed by the private individuals who own the other plant, to purchase and sustain the opposition plant.

The President: There is another view, that is, the difference between the manufacturing and the electric light plant. If we were on the same basis as a manufacturing institution, and could move, we would not bother with the municipality, but we are tied down, and have capital invested which cannot be moved. We hear every day of offers being made to factories to move to other towns, but lighting companies do not have that advantage.

Mr. A. A. Wright: This is a very difficult subject to handle; there are so many interests at work. There are the political enemies and the aspirants to office which you have to deal with, and a certain class of people and a certain class of supply men. I know of one supply company that sent their best man into our town to work up an opposition plant, and they succeeded in doing it. I remember it and will remember it for a long time, but, fortunately for our town, I don't think there is much danger of their going into the electrical business, because they are involved in debt and cannot do it. However, I think they would be inclined to treat us fairly if they did. With reference to our keeping a sharp eye on the electrical supply men, I

think we should do this, but still you must understand this is a very dangerous ground, for these men who are our opponents, by telling half the truth, will make the people believe that we have arranged with the supply men not to sell to municipalities either plants or supplies. So we have to be very careful what we say and do, but it is well to let the supply men know that although we don't do a great deal of talking, we do a lot of thinking, and although we don't ask that they tell the municipalities that they won't sell them a plant, still, at the same time, they should, in justice to themselves, because it is the electrical men who are going to buy their supplies, be very careful and throw all reasonable cold water on the scheme. I think we should make every exertion to secure that amount of legislation which will protect us from new plants. It seems to me that that is the place where our strongest defence should be, and that our energies should be earnestly devoted to this matter.

Mr. Hill: There is another phase of this question worthy of consideration. Mr. Wright has stated that we should watch the electric supply men. Now, the electric supply man is out for business pure and simple. I am speaking now of Canadian electrical supply men. If he can get the electrical business of Canada he is satisfied, but where the managers of certain companies come to the conclusion that all they have got to do is to go across the border to buy their plant and supplies, the electrical supply men think that the town in which his company operates is not one that is assisting home industries, and immediately attacks that town. We have got to patronize one another, and where we find we cannot approach the manager of electrical industries at present in Canada, we are bound to get into that town if we possibly can, and use our energies to secure that portion of the trade.

Mr. A. A. Wright: I don't think there are many owners of plants but that always give the preference to Canadian supply men, and I think that the majority of supply men treat us fairly. There are members of churches who are not very good Christians, and there are also members of the supply fraternity who are not good business men. Really, I think if the supply men would tell the whole truth it would be better.

Mr. Hill: We generally do that.

Mr. Johnson: There have been manufacturers who have made it a policy never to interfere with a local illuminating company in the way of starting a plant in the same town or inducing the municipality to go into the business, but on the other hand I can say that there are manufacturers who have done both of these things, and there have been other cases where the illuminating company's employees have gone so far as to instigate and encourage the starting of a municipal plant in another town, and have done it in the shape of a fee for the consulting engineer.

Moved by Mr. J. J. Wright, and unanimously resolved, that the report of the Legislative Committee be adopted, and that the Committee be continued as a part of this Association and instructed to prosecute the work.

Mr. Reesor, on behalf of the committee appointed to name standing committees for the ensuing year, reported as follows:

Committee on Statistics—J. A. Kammerer, Toronto; A. A. Wright, Renfrew; S. J. Parker, Owen Sound.

Committee on Meter Inspection—A. A. Dion, Ottawa; E. E. Carey, St. Catharines; J. J. Wright, Toronto.

Committee on Legislation—A. L. Breithaupt, Berlin; C. Berkley Powell, Ottawa; John Yule, Guelph; C. B. Hunt, London; B. F. Reesor, Lindsay; J. J. Wright, Toronto; W. H. Comstock, Brockville; F. Pepler, Barrie.

This selection of committees was unanimously approved of.

The President: The next item is the deciding of the place of meeting for next year, and in that connection

I have an invitation from the Cataract Power Company, of Hamilton, which I will read:

HAMILTON, Canada, June 25, 1898.

C. H. MORTIMER, ESQ.,

Sec'y Canadian Electrical Association, Montreal.

DEAR SIR,—The Cataract Power Company takes pleasure in extending to the Canadian Electrical Association its most cordial invitation to hold its next annual convention in the city of Hamilton.

We will by that time have some matters of modern electrical engineering, as well as the industrial applications of electric power, which would probably prove of interest to the members of the Association.

We trust that we shall have the opportunity of entertaining the members of the Association at their next meeting.

Yours truly,

THE CATARACT POWER CO. OF HAMILTON, LIMITED.
H. R. LEYDEN, General Manager.

After the reading of the invitation, Mr. Black, of Hamilton, said: I have been thinking for some time that we should go to Hamilton. I feel a little reluctant in moving that the convention go to Hamilton, following after Montreal. They have treated us so well here and promised us so much to come, that I fear that a visit to Hamilton will be tame after being in Montreal, still I think there is hardly another place in the Dominion where you will be so well treated as in Montreal, but you have to take the little with the great. I move, therefore, that the convention go to Hamilton.

Seconded by Mr. Wyse, of Brantford.

Mr. Gordon J. Henderson: Representing the Hamilton Electric Light & Power Co., I beg to join with the Cataract Power Co. in asking you to come to Hamilton. The work which has been done at St. Catharines so far will, I am sure, prove a benefit to any who come to Hamilton next year. We will do our best to make your stay enjoyable, and trust you will accept the invitation.

On the motion being put to the meeting, it was adopted unanimously.

The President: The next item on the programme is "General Business."

Mr. J. J. Wright: Under that head I would like to have taken up the remuneration of the Secretary of the Association for services during the past year, and move that it be made \$125.

Mr. Reesor: I second the motion.

Mr. Kammerer: I also second the motion. I know the amount of work done during the past year, and there is no doubt whatever that it is worth a great deal more than the amount which has been named.

The President: For the past two years I have also known the work that Mr. Mortimer does, and know that \$125 is not half enough for the work there is connected with this organization.

The motion was adopted unanimously.

Mr. Hill: I would like to ask if it is the intention of the Association to take any steps in the matter of the action of the Underwriters' Association in regard to inspection, etc., and whether it is the intention to adopt any of the numerous sets of rules that are upon the market, and whether we are to take any action in conjunction with the Fire Underwriters' Association to try and adjust this matter. I don't know whether it is a matter of very great importance to the members from Ontario, but I can say that, speaking from a Montreal view, it is a matter of very great importance. The way in which we have been treated by the underwriters during the last year or two has been, to say the least, very unsatisfactory. We do not know where we stand to-day or where we will stand to-morrow. To-day it is iron-armored conduit; to-morrow it is flexible cord; the next day it is wire on cleats, and the day after wire without cleats, etc. The rulings have been simply surprising, and we think it is about time that the Canadian Electrical Association should take a stand in this matter, and that members should feel that they are not going to be run by inspectors not capable of filling the positions they hold. I therefore bring the matter before you.

Mr. Dion: I am very glad this matter has been brought up. I think we have reached a stage in some parts of the

country, in our relations with the insurance inspectors, that calls for some sort of united action on the part of this Association. In Ottawa we have a peculiar state of things. We have a lot of buildings wired years ago when underwriters' rules were not known, and also later when underwriters' rules did exist, but when they were not enforced. It was then in the power of the underwriters to start things right, but they did not, and so things got into a certain groove and continued so until a few years ago. Our company had decided to do no more wiring. Some men without any experience then undertook to do wiring, and it was necessary for the electric companies to protect themselves against bad wiring, and for that purpose they came to the conclusion that no connections would be made to a customer's premises until an underwriter's certificate had been granted. From that day to this we have adhered strictly to that rule, very often to the inconvenience and the annoyance of our customers who were in a hurry to get the light. The result is, that for all customers since that day, we have an official certificate from the underwriters. This certificate has been granted by the official inspector, who, I understand, is under the Ontario branch of the Underwriters' Association. Now, the Quebec board or branch, which seems, as far as I can judge, to have no connection with the Ontario branch, have sent special inspectors, who make reports at variance with the local inspector. A Quebec inspector made an examination of a number of places and made a report which is very damaging in some respects, and unjustly so. Among the places he reported against were a number which had been certified by the local inspector not long ago. Now the proprietors resent this, and they don't want to get the wiring done again, and state, "We have a certificate that the installation has been done in accordance with the underwriters' rules, and if we proceed to have more changes made what guarantee have we that in three or four years we may not be asked to have it done all over again." As far as we are concerned, we don't object to a good set of rules, but we think that there are circumstances where some allowance should be made. My object in speaking about this is to invite discussion so that I can find out what other electric light companies in other cities are doing in the matter. We propose sending a representative from our Board of Directors to confer with the underwriters here in Montreal so as to arrive at a better understanding, and I think it would be well for me to find out what others are doing before proceeding, as it would not be wise for us to move on behalf of Ottawa and some other party on behalf of another town take another stand, but we should all work together.

Mr. W. B. Shaw: Speaking as a supply man and electric light man, and representing construction interests, I have great sympathy with what Mr. Dion has said. I think Mr. Dion must refer to the same inspector who refused to pass on a shunt rheostat because the wires in it were not insulated. I know of one customer here who has given us carte blanche to fill the underwriters' requirements. His wiring was condemned in 1895 by an inspector who was a painter a few weeks before that, and the following year by an inspector who, I believe was a mechanic, and the third year by another inspector whose previous business I don't know. As this customer has given carte blanche to do what the inspectors wanted, he naturally asks now if he has to do something every year. We don't know where we are standing.

Mr. Hill: In order to put this in a proper way for discussion, I would move that the Canadian Electrical Association request the Fire Underwriters' Association of Canada to appoint a competent inspector for the Dominion, whose decision on questions of electrical inspection shall be final, and that we adopt the rules of the National Board of Fire Underwriters.

Seconded by Mr. W. B. Shaw.

The President: My opinion is that the appointment of a small committee to confer with the Association would be a better way to go about it.

Mr. Wyse: The underwriters have the powerful leverage of saying that they won't insure a building

that has not been wired in accordance with their rules, and can, therefore, dictate terms to suit themselves. I agree that a committee should be named.

Mr. Dion: Who are the underwriters that are dealing with us? Are they not the Canadian Board of Fire Underwriters' Association?

Mr. Smith: I think I can give Mr. Dion some information. The provinces of Ontario and Quebec are divided by the line of the Kingston and Pembroke Railroad. Everything east is handled by the underwriters with headquarters at Montreal. Everything west is under the control of the Board of Fire Underwriters with headquarters at Toronto, and there is, of course, a central association, but the direct cause of the whole of your trouble comes from the management here in Montreal. If anyone has anything to say about trouble in the west, I am here to answer.

Mr. Dion: Although we are in the eastern district, our local inspector draws his salary and receives his instructions from Toronto.

Mr. Smith: No, he has been entirely under the control of the board at Montreal.

Mr. Dion: Well, he certainly informed me otherwise. One thing I wish to mention is that the local inspector has got the Canadian Underwriters' Code of Rules, and the last inspector who came from Montreal judged the installation under the National Code, and there is, of course, quite a difference between them. The local inspector says he has never received instructions to change the code. Another thing that I wish to mention is that a great deal of the trouble has been due to the fact that the inspections have taken place after the work has been finished. What we want is better local inspection, so that troubles will be discovered immediately after they occur, and not some time after the work is completed.

Mr. Browne: The question of fire underwriters' rules has necessarily been a matter of progress, and in the formulation of these rules undoubtedly a great many grievances have been created. It has been part of my experience to work under the most severe inspection of underwriters' rules, and we found no difficulty in complying with them. I agree with Mr. Dion that in the Quebec section there has been a total absence, until a very short time ago, of any attempt of controlling the method of wiring, and the result is that there is a great deal of bad wiring now extant in Quebec province. Our own experience in this city is unsatisfactory, because there is no established head representing the Board of Fire Underwriters. The Board of Fire Underwriters seems to assume that because they have established rules we will all follow them explicitly and honestly, and that we are so honest, all of us, that we don't need an inspector, and the result is that when they are called upon to make an inspection they often find work done in contravention of the well-known rules. There is not a company in Quebec that does not know that the Quebec Board intend to have the Canadian Fire Underwriters' rules carried out, which are an adaptation of the National Electric Light Association rules. It would be well if a committee from the Canadian Electrical Association, representing those particularly operating in Quebec, could be organized to bring the Quebec Association into the condition that they would appoint an inspector and give him a set of rules, and not leave it to his arbitrary decision to change, so that when we do a piece of wiring we will know it is all right. We don't want an inspector to come around and say, "We want something else done." We must apply to the Canadian Board and get them to appoint an authorized inspector, instead of having one for Ontario, one for Quebec, etc.

Mr. Hill: There are two points that have been brought up at this discussion. The first is the question of the committee. I may say that it has been my pleasure, and at the same time my labor, to go before this Board of Canadian Fire Underwriters in my capacity as a humble citizen, in my capacity as an electrician, as one in the supply trade, and one of the committee of an as-

sociation we had here, called the Montreal Electric Association. In all these meetings we have done our utmost to have the Fire Underwriters educated up to the proper point, but our meetings have been more than unsatisfactory, for this reason which I want to emphasize, that there is no head, as Mr. Browne has said, and my intention of putting in one head for the Association is that we can get a set of rules for the provinces of Ontario and Quebec alike. Now, if they had a head of that sort, when it came to be a question as to whether interior conduit should be fixed to a brick wall or put through clay tubes, it would not be for an inspector to finally decide on the large installations, but it would go to the head authority, who would be the Dominion Inspector, and it would be his duty to give that decision and stick to it. The great difficulty has been that the inspector has given his decision one day and gone back on it the next, simply because he could not stick to his original decision or had been bought up by somebody. Now, this is a very important question to the members of Quebec, and I think it would be wrong to put it in the hands of a committee, because I believe nothing would come of it. I think if we put before the Fire Underwriters a resolution of this nature, calling upon them to put in a head of that department, that we will gain a point.

Mr. A. A. Wright : If these other gentlemen are in a peculiar position, what kind of a position am I in? The Kingston and Pembroke Railway runs right through the town. Half the town will be on one side and half on the other. (Laughter.)

Mr. John Shaw : Mr. Dion has a kind of compulsory inspection in Ottawa, but we have none here. I know where one of our power companies refused to give light to a building on account of the objection to the wiring, and the consequence was that the party turned around to another company and had the thing done. The whole question is, that this inspection to be of any use must be compulsory, and we should have a municipal law making it so.

Mr. Browne : I indicated in my remarks the very idea that Mr. Shaw has just spoken of—the absence of official authority. I may say that our company has solicited the secretary of the Quebec board to appoint some one with authority to compel the certifying of every installation by the inspector, and that he be given a specific set of rules to be followed, out and that from date all work should be done in accordance with those rules. We have not been successful in having that inspector appointed, and our company is, in its own way, undertaking to impose obligations as to the wiring, but we are frequently met by this condition, that when we undertake to refuse to give light because the wiring has not been properly done, the prospective customer says we have an interest in it because we want to do the wiring and leaves us. If we can get a representative committee of this Association to meet the Quebec Board of Fire Underwriters and impress upon them, if possible, the necessity of appointing some man and giving him a set of rules, we will accomplish a great deal. I believe it to be to the best interests of this Association and of our business generally to secure that. I think in Toronto that Mr. Smith has a good system in force and a fixed set of rules. There is another factor in the case, that is, the American Factory Mutual Associations, who have still more rigid rules than the Canadian Underwriters, and they insist on having the rules complied with. It is not a question of how severe the rules are, but the fact that they will be adhered to. As to the insurance, perhaps your municipal law will cover that. I would have no objection to a municipal officer. All I care about is some authority to regulate this matter.

It was moved by Mr. J. J. Wright as an amendment to Mr. Hill's motion, seconded by Mr. Wyse, of Brantford, "That a committee of the Canadian Electrical Association be appointed, consisting of Messrs. P. G. Gossler, A. A. Dion, F. H. Badger, jr., and Alderman Sadler, to interview the Quebec Board of Fire Underwriters and the municipal authorities in regard to the adoption of permanent rules governing electric installa-

tions and a means of enforcing compliance with the same."

(The above amendment is as finally put to the meeting and not as originally proposed).

Mr. Hill : With reference to the amendment, I would say that I would be willing to withdraw my motion provided Mr. Wright will attach the name of some one who is interested in this question. The men who have been most hurt by the inspectors have not been the electrical companies, but the contractors ; and if the contractors—who are an important section of this Association—are not to be recognized as having any say on this subject, I think it wrong. I would therefore suggest that Mr. Wright add to the committee Mr. W. B. Shaw.

Alderman Sadler : Mr. Shaw and Mr. Browne have mentioned the matter with regard to a municipal law. I would like to say to the convention that the building by-laws of the city of Montreal have been somewhat changed ; a committee, consisting of some of the aldermen and also of members of some of the different trades, such as plumbing, etc., have met on a great many occasions during the past eighteen months. Those laws have not been adopted yet by the council, and it seems to me that in fixing a committee, it might be well if they intend to establish certain rules, to have them embodied in some form in the municipal by-laws, because you might come in conflict with our building inspector, and I think it necessary that any laws relating to buildings should also be accepted by the building inspector. If you deem it wise, I would suggest that that committee confer with some of the city representatives ; in fact, as far as I am concerned, I will be only too glad to assist when the building by-law comes up.

Mr. J. J. Wright : With the permission of my seconder, I would amend that motion so as to include conference with the municipal authorities and also add the name of Alderman Sadler.

Mr. Browne : I would suggest that Alderman Sadler remain on the committee. Although in his capacity as representing the city, he would be able to do for us whatever may be necessary there, yet being a member of the committee, working for them, he would be able to present to the council the views of the Association. It has been suggested by Mr. Shaw and also another party that a wiring contractor be added to the committee, and for that part, if Mr. Wright will consent, I would suggest the addition of the name of Mr. W. B. Shaw.

Mr. J. J. Wright : I decline to make any alteration in the amendment.

Mr. Hill : Speaking to the amendment, I would be willing to withdraw the main motion provided I felt the amendment was going to thoroughly cover the point. This is not with me a question of to-day, and I feel that to do full justice to the subject you must widen the scope of that committee. There are very wide interests not represented there, and I fail to see why the mover of the motion, who has been asked by the seconder, refuses to put on that committee a representative from the province of Quebec who has an interest in that committee.

On the amendment being put to vote, 27 members voted yea, and 2 members nay, whereupon the President declared the amendment carried.

Dr. J. K. Johnston then presented his paper, entitled "Experiences of an Inspector." (See page 145.)

DISCUSSION.

Mr. J. J. Wright : Taxers as a rule are not very popular, but in this case I am glad to say that the relations between the taxer and the taxed, as far as I can see, have been of the most amicable nature. I have pleasure in moving a vote of thanks to Dr. Johnston for the good feeling expressed in his paper.

Mr. Dion : In seconding the motion I might, perhaps, refer to the last part of Dr. Johnston's paper, suggesting that there may be some potent charm about electricity. I think this is a phase of an electrician's char-

acter that we sometimes overlook, that on account of his coming in contact with so many kickers he cultivates patience and becomes a very genial person.

As Mr. James Milne was unable to be present at the convention, Mr. Weeks kindly read his paper, entitled "The Steam End." (See page 152.)

DISCUSSION.

Mr. Hunt : I suppose it is on account of Mr. Milne's bashfulness that he does not enlarge on the mechanical firemen he speaks about. I may say we have some of these in use, and they are giving good results. I have much pleasure in moving a hearty vote of thanks to Mr. Milne for his paper.

Mr. J. J. Wright : Mr. Milne was right in giving credit to the firemen, as a great advantage can be obtained by the employment of a superior class of firemen. I see his modesty prevents his coming out more strongly in that regard, but the apparatus that Mr. Milne is interested in has every advantage over the ordinary run of such things. It undoubtedly has merits in a good many ways, in its saving of fuel and labor and prevention of smoke. I should like to have discussed these matters more fully, but our time is too limited to go into them.

A paper was then read by Mr. Bonner, entitled, "The Quimby Screw Pump." (See page 149.)

DISCUSSION.

Mr. Thompson asked if the Quimby pump could be used for the ordinary purposes of a suction pump, and Mr. Bonner, explaining that Mr. Quimby was present, asked permission to call upon that gentleman to reply to the enquiry.

Mr. Quimby said : I am much obliged for your permission to address the meeting, and answering the question brought up, the pump described can be used for a suction pump for 10 or 12 days without priming, and if primed will hold anything up to 28 or 30 feet. The pump will answer all the conditions which will be met by any ordinary plunger pump. I recommend them primed at 20 feet, which is about as much as you should run any pump without watching it.

Mr. Reesor : I beg to move a vote of thanks to Mr. Bonner for his able paper.

Seconded by Mr. J. A. Kammerer and carried.

The President then declared the meeting adjourned until the following day at 9:00 a.m.

The afternoon was devoted to a visit to the works of the Lachine Rapids Hydraulic and Land Co., by joint invitation of the owners of the works and the Canadian General Electric Company, by whom the electrical plant was manufactured. Mr. W. McLea Walbank, managing director of the company, was present to give information regarding this important enterprise. After an inspection had been made of the works, the visitors were invited to partake of luncheon, which had been provided by the Canadian General Electric Company. Before starting on the return trip, a very hearty vote of thanks was moved on behalf of the visitors by Senator Thibeaudeau to Mr. Walbank, the directors and officers of the company, and the Canadian General Electric Co., for the courtesies so kindly extended to members and friends of the Association.

THE BANQUET.

The annual Association banquet was served in the Windsor Hotel on the evening of June 29th, and was attended by nearly 150 members and guests. The retiring President, Mr. John Yule, presided, and fulfilled the duties of toast-master.

The Secretary read letters of regret from a number of persons who were unable to be present. Among these was one from Mr. F. C. Armstrong, written while en route to England, the reading of which was followed by the company rising to their feet, at the suggestion of Mr. W. H. Browne, and singing, "He's a Jolly Good Fellow."

MENU.

LONG-DISTANCE TRANSMISSION.

Fire Island Cocktail—50,000 Volts.

INTERNAL RESISTANCE.

Cucumbers. Radishes. Tomatoes, Strain Insulators.
Olives, triple Braided.

ELECTRIC JUICE.

Green Turtle, a la Water Rheostat.
Cream of Asparagus, a la Ozone.

SUBMARINE.

Saguenay Salmon, a la Hello. Potatoes, Rachel.

SHUNTS.

Spring Lamb Cotelettes, Carbon-Trimmed. Sweet Breads.
Asparagus—"Arrester" Points.

JOINTS—"Soldered and Taped."

Fillets of Beef, Larded.

RELAYS AND SOUNDERS.

String Beans. Boiled New Potatoes, Anchors. Cauliflower.
Asparagus. Sweet Peas.

TROLLEY OFF.

Punch au Champagne.

RECONSTRUCTION.

Roast Philadelphia Capon.

PLANTS.

Lettuce and Tomato Salad.

BOOSTERS.

Cabinet Pudding, "sound-proof."
Gelee aux Oranges, "insulating compound."
Savarin aux Aananas, "Vacuum Light."
Vanilla Ice Cream, "self cooler."
Sponge Cakes, "Leather Belting."

DESSERT.

Fruits, "potential currents." Nuts and "wrenches."

ELECTRIC HEATER. INCANDESCENCE.

Cafe Noir. Cigars.

TRANSFER. RING OFF. OPEN CIRCUIT. "30."

The appended copy of the menu will suffice to show its unique and excellent character. The toasts honored on the occasion were : "The Queen," "Electrical Montreal," "Our Association," "Our Guests," "Electrical Research," "Allied Interests," "The Press" and "The Ladies." His Worship, Mayor Prefontaine, responding to "Electrical Montreal," gave a number of interesting and instructive particulars regarding the electrical development of the city. The Royal Electric Co. began in 1884 with a dynamo of 13 arc light capacity, a dozen employees, a small workshop, and a capital of less than \$50,000. To-day it has a manufactory covering an area of about 40,000 square feet. The total employees of the company in its manufacturing business is upwards of 500 ; its capital invested upwards of \$2,500,000. In 1886 the streets of Montreal were first illuminated by electric light, 113 lights being then placed. To-day there are nearly 1,500 street lights. The Chambly Manufacturing Company's enterprise, by which electric current will be transmitted to Montreal not later than September next, represents a development to the extent of 20,000 horse power. Another enterprise which was a credit to Montreal was the Lachine Rapids Hydraulic and Land Company's development, where a capital of nearly \$2,500,000 is being expended to harness the St. Lawrence. In August, 1892, the street railway began operations by electric power, with two dynamos, of a total capacity of about 500 horse power. To-day it has installed a capacity of about 10,000 horse power. They have 80 miles of track. In 1894 the Montreal Park and Island Railway was begun. It is now running to Back River, Outremont, St. Laurent, Cartierville, Westmount and Lachine. It has a track mileage of about 60 miles. The Bell Telephone Company has somewhere about 8,000 telephones in use in the city, besides those of the Merchants' Company, numbering about 1,200.

Hon. Senator Thibeaudeau, speaking for "Our Guests," referred to the transformation which electricity in its varied applications had wrought throughout the Dominion.

In the absence of Prof. Herdt, due to illness in his

family, Mr. W. H. Browne ably responded to the toast, "Electrical Research."

The "Allied Interests" were responded to by Ald. Sadler and Mr. D. A. McDonald, Montreal; Messrs. C. L. Weeks and J. A. Kammerer, Toronto; Mr. E. E. Cary, St. Catharines.

Mr. B. A. MacNab, formerly a knight of the telegraph key, responded for "The Press," and for "The Ladies," Dr. W. H. Drummond recited a poem descriptive of the heroism of a young Quebec girl, Madeleine Verchere, in 1692. Dr. Drummond in like manner favored the company at an earlier stage in the evening.

In addition to the pleasure derived from the presence of an excellent orchestra, the company greatly enjoyed the singing of Mr. Fred. Hickey, Mr. J. R. Wilkes and Mr. Ernest R. Jenkling.

THIRD DAY.

The convention re-assembled at 9:30 a.m., when the election of officers was proceeded with.

For the office of president Mr. Cary nominated Mr. W. H. Browne, of Montreal. This was seconded by Mr. John Shaw, and meeting with universal approval of the members, Mr. Yule declared Mr. Browne to be the unanimous choice of the Association for the office of president for the ensuing year.

Mr. J. J. Wright nominated Mr. H. P. Dwight, of Toronto, for the office of first vice-president. Mr. Dwight was declared to be unanimously elected.

Mr. J. A. Kammerer nominated Mr. A. A. Dion, of Ottawa, for second vice-president. Carried unanimously.

The following members were elected to constitute the Executive Committee: J. J. Wright, A. B. Smith, Toronto; John Carroll, William Thompson, W. McLea Walbank, Montreal; G. J. Henderson, H. R. Leyden, George Black, Hamilton; O. Higman, Ottawa; E. E. Cary, St. Catharines.

A hearty vote of thanks was tendered to Mr. Yule for his services as president of the Association during the past two years.

It was moved by Mr. J. J. Wright, seconded by Mr. A. A. Wright, and resolved, that the most hearty thanks of the Association be tendered to the following gentlemen for the very handsome manner in which they have looked after the interests and comfort of the visiting members and for hospitalities extended: Members of the Reception Committee; Montreal Street Railway Co.; Canadian General Electric Co.; Lachine Rapids, Hydraulic & Land Co.; Montreal Park and Island Railway Co.; Royal Electric Co.; Chambly Mfg. Co.; McGill University; Montreal Belt Line Railway Co.; Windsor Hotel Co.; Great North Western Telegraph Co.; Canadian Pacific Railway Telegraph Co.; Bell Telephone Co.; R. E. T. Pringle; Packard Electric Co.; Eugene Phillips Electric Co.; Dominion Wire Mfg. Co.; Ness, McLaren & Bate; D. W. McLaren Co.; Sadler & Haworth; W. T. Bonner (Babcock & Wilcox Co.); W. E. Gower (Street Railway Chambers); members of the local press.

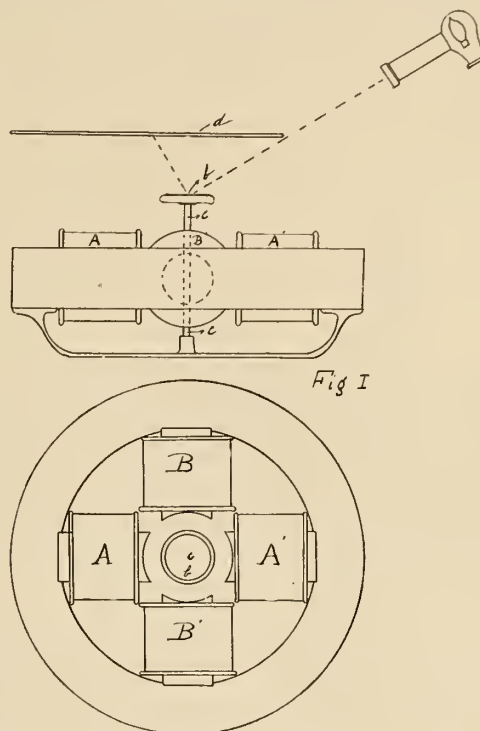
VISIT TO MCGILL UNIVERSITY.

Upon adjournment, the members and their friends proceeded to McGill University. Experiments had been prepared in the electrical laboratories in view of the visit of the members of the Association, but, owing to the little time at their disposal, all of the experiments prepared could not be carried out.

In the McDonald Engineering Building, the experimental rooms, testing rooms and laboratories were thrown open to the visitors, and the extensive collections of standard instruments, models, etc., called forth loud praise from the visitors.

In the dynamo room, the very fine equipment of dynamos and motors was seen running. Of special interest to the electrical fraternity was the 12 k.w. Mordey alternator, the coils of which can be moved round through any angle and two or three currents of any phase difference obtained. The mains leading from this

machine are led to the high tension current laboratory on the floor above. It is there that the special work of research on alternating current is carried out. A speed indicator and speed regulator of a novel form enables the experimenters to regulate at will the speed of the

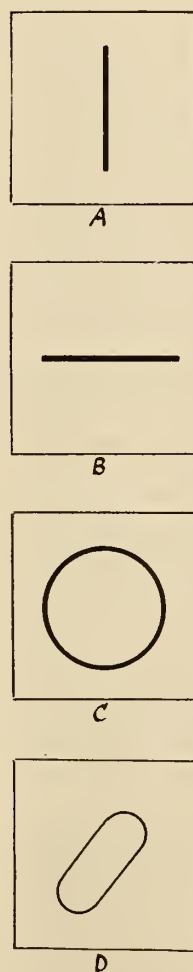


motor driving this alternator. A little model of a two-phase motor, as shown in Fig. 1, was set up. It consists of a ring of cast iron, with four inside polar projections.

There are four bobbins wound on these. The windings A and A' are in series, and independent of windings B and B', also in series. In the centre is placed a flexible cast iron rod, C, firmly held at one extremity; the other end carries a plane mirror, b. A ray of light is thrown on this mirror, and is reflected on a pane of ground glass, d.

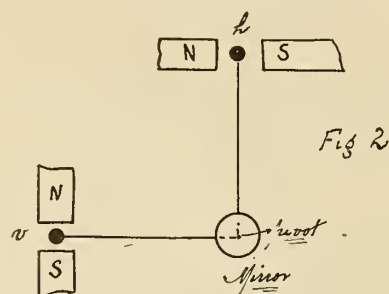
If an alternating current is sent into the coils B and B', a pulsating field is produced, and the rod C will be set vibrating. A stream of light will be cast on the glass, as shown in diagram A. If a second alternating current of 90° difference of phase is sent into windings A and A', a pulsating field is produced at right angles to the first one, and will cast a ray of light as shown in diagram B. If the two currents are acting at the same time and are of the same value, a rotating field is set up; this rotating field is shown by a circle clearly drawn out on the plate C. If the difference in phase between the two currents is more or less than 90°, the curve drawn out is no longer a circle, but will be of elliptical form. A number of interesting experiments can be carried out with this very simple apparatus. A little drum of copper placed inside the motor will start to rotate.

Another apparatus (Fig. 2) for similar work, but of much greater value and more remarkable results, was also set up. It was devised by Prof. Carus-Wilson, and consists of a small mirror pivoted at its centre and attached to a wire, v, capable of a vertical displacement, and also to another wire, h, with a horizontal displacement. These wires, in which were passed alternating currents, are placed in constant magnetic fields. The



mirror, following the relative displacements of the wires v and h , and through a reflected ray of light, beautifully draw out the approximate line curves of the alternator.

In the lecture theatre of the Physics building the visitors were shown each in turn the power of the X rays to throw a shadow of one's anatomy on the fluorescent screen. They were then given a demonstration of the



breaking down of the insulation afforded by a large glass plate by a very high potential alternating electric discharge. For this purpose a large induction coil was used as a transformer, the primary being connected to the street mains. The demonstration was closed by a display of a few of the fine Geissler tubes belonging to the well-known collection of the McDonald Physics building. The lighting and power plant of the University was also inspected by the visitors.

At 1 p.m. a visit of inspection was made to the headquarters of the Bell Telephone Co. and the manufacturing and lighting station of the Royal Electric Co. At 3 p.m. members and invited guests were conveyed by special train to the electric transmission works of the Chambly Manufacturing Co., where luncheon was served.

The convention then closed.

SPARKS.

The town of Thorold purposes extending its electric light plant, and will issue debentures for \$7,000 for the purpose.

The ratepayers of Listowel, Ont., recently defeated a by-law to provide funds for increasing the electric light plant.

It is claimed that the necessary capital has been secured to build the proposed Lanark and Perth electric railway.

The Lakeport Preserving Company have given an order for the installation of a lighting plant for their factory to the Canadian General Electric Co.

The Toronto Railway Co., who recently ordered a number of Canadian General Electric C.G.E. 1000 motors, has given an order for additional equipments.

The town of Whitby, Ont., invites tenders up to July 30th for lighting the streets of the town. Thomas D. Jackson is chairman of the Committee on Street Lighting.

The Central Electric Light Co., of Portage la Prairie, Man., are said to have under consideration the equipment of a telephone exchange, in opposition to the present company.

The city of London is advertising for tenders for the supply of an electric light plant of 350 2,000 c.p. capacity, together with steam plant for operating same. Tenders close August 3rd.

The Hull Electric Co. recently elected the following board of directors; Messrs. A. Fraser, president; W. J. Conroy, vice-president; C. Magee, J. B. Fraser, R. J. Conroy, W. N. Taylor and David MacLaren.

The Laprairie Bay Ice Co., with a capital of \$100,000, has been organized in Montreal, for the purpose of supplying ice cut by a patent electric ice-cutting machine, the invention of G. D. Pearson. Power for operating this machine, as well as for an electric hauling apparatus, will be obtained from the Lachine Rapids Hydraulic & Land Co.

The Lachine Rapids Hydraulic and Land Company, of Montreal, have given an order to the Canadian General Electric Company for the installation of a seven panel power house switchboard, which is to be built in accordance with specifications and drawings prepared by R. S. Kelsch, superintendent for the Lachine Rapids Co.

The Canadian Pacific Railway, which have recently acquired the smelter at Trail, B.C., formerly operated by Aug. Heinze, have concluded negotiations with the West Kootenay Power & Light Co. for the supply of electric current to operate their smelter, and have ordered from the Canadian General Electric Co. two 75 k.w. three phase revolving armature type synchronous motors, which will be operated at a potential of 550 volts. They have also ordered three 50 h.p. induction motors and three 30 h.p. induction motors, which will also be operated at a potential of 550 volts.

British capitalists are said to have secured a controlling interest in the New Westminster & Burrard Inlet Telephone Co., of Vancouver, B. C.

Edward Slade, electrical contractor, of Quebec, is installing an electric plant in the steel boat Orleans, plying between Quebec and St. Tetreille.

The Robb Engineering Co., of Amherst, N.S., has received an order for two engines of thirty horse power each, for running blowers in the works of the Verity Plough Company, Brantford, Ont.

The electric light plant of McCurdy & Co., Antigonish, N.S., is being extended, the company having secured the contract to light the streets of the town. The Robb Engineering Co. are supplying the engine and boiler.

The R. Forbes Co., Limited, of Hespeler, Ont., have placed an order with the Canadian General Electric Co. for two 500-light generators. These generators will be of the Canadian General Electric Co.'s latest four-pole type.

The City Council of St. Thomas, Ont., have appointed a committee, consisting of Aldermen Chant, Wallace, McCully, Sanders and Robertson, to report as to the advisability of establishing a municipal electric plant for street lighting and commercial purposes.

The West Kootenay Power & Light Co., who have just closed a contract with the C. P. R. authorities for the supply of electric current to operate their Trial smelter, have placed an order with the Canadian General Electric Company for the supply of three 135 k.w. transformers of the well known air blast sub-station type.

The Dominion Telegraph Co., at its annual meeting held last week, re-elected directors as follows: Thomas Swinyard, president; Hon. Sir Frank Smith, vice-president; General Thos. T. Eckert, Chas. A. Tinker, A. G. Ramsay, Henry Pellatt, Hector Mackenzie, Thos. F. Clark, Thos. R. Wood, and F. Roper, secretary and treasurer.

The town of Barrie, Ont., recently invited tenders for an electric light plant, to be operated under municipal control. It is understood that a number of tenders were received, and that the Electric Light Committee have recommended that a by-law be submitted to the Council to raise the sum of \$35,000 to purchase and install a plant for arc, incandescent and power services.

The attention of the electrical fraternity and others interested is directed to the advertisement of the Croftan Storage Battery Company on another page, and also to the description of the battery which appears in this issue. The Croftan battery undoubtedly has many points of merit, and the company have good prospects of building up quite an extensive business in Canada.

The Napanee Electric Light & Water Co., which has been supplying lights for the streets of Napanee during the past ten years, has decided to go into the incandescent electric lighting business, and for this purpose has placed an order with the Royal Electric Co. for a 35 k.w. two phase generator and 500 light capacity in transformers. The company has already secured in the neighborhood of 400 lights, and expect to have the generator fully loaded within the next two or three months. They are arranging the plant so that an enlargement can easily be made.

The Lang Tanning Co., of Berlin, Ont., have recently given an order to the Canadian General Electric Co. for a 100 k. w. multipolar direct current dynamo, which will be operated at a potential of 250 volts. This generator will supply current for the operation of two of the Canadian General Electric Co.'s latest type of multipolar direct current motors, each having a capacity of 50 h.p., and one 10 h.p. motor. The order given to the Canadian General Electric Company also includes the installation of a marble panel switchboard containing the necessary instruments for the operation of the plant, and the wiring up of their factory.

The second annual meeting of the Canadian Telephone Co. was held at Sawyerville, Que., on June 27th, when the following were elected directors for the current year: J. Laroche, Sawyerville; A. Adam, Paquetteville; Jos. Lemieux, St. Malo; P. A. Barbeau, Cookshire; Jas. Hunt, M.L.A., Bury; F. F. Willard, Angus; E. Roberge, Notre Dame des Bois; N. P. Tanguay, Weedon; and M. Matheson, Lake Megantic. Mr. H. Laroche was re-elected president, Mr. Joseph Lemieux general manager, and Mr. J. Fournier secretary-treasurer. A dividend of 5 per cent. for the past year was declared. The report stated that the company had built during the past year 60 miles of poles, with 114 miles of wire, and actually owned 220 miles of poles and 347 miles of wire. The company have 12 exchanges, with 322 subscribers.

Last week the town of Perth, Ont., was visited by the largest fire it has experienced since its existence. The new waterworks system was put to a practical test and worked admirably. The water pressure remained perfectly steady and even. This is, we believe, the first instance in Canada where the waterworks pumps were electrically driven, and from the satisfaction given at Perth by the use of electrical apparatus, other cities with the waterworks operated from a steam plant, and where electrical power is available, will no doubt sooner or later adopt the use of electricity. The installation of the pumps, generators and motors was conducted by the Royal Electric Co., and the motor used for pumping purposes is one of their 75 k.w. "S.K.C." two phase machines operating as a synchronous motor from a 180 k.w. "S.K.C." generator situated at a water power six miles distant.

The corporation of the city of Joliette, Que., is remodelling their entire system of electric lighting. This corporation has a water power in the city which has been utilized for supplying arc and incandescent lighting throughout the city. The contract for the work has been awarded to the Royal Electric Co., who will supply a 180 k.w. "S.K.C." two phase generator and the necessary arc apparatus to replace all the old machinery. The matter of making the change has been hanging fire for a long time, and after consultation with the best engineering skill obtainable the council came to the conclusion that it would be better to change over the whole plant than to repair the old apparatus, or make additions of less efficient or up-to-date apparatus. The changing of this plant should be gratifying to the electrical trade, as it shows the trend of investors, and the corporation of Joliette is also to be congratulated on the up-to-date stand which they have taken in the matter.

ELECTRIC UTILIZATION OF WATER POWERS.

By L. D. W. MAGIE.

THE utilization of power going to waste in fast running streams has commanded for many centuries the attention of mankind. Regarded, on the whole, as "wasted energy" and as power that could be obtained "for nothing," the question of how to make it useful perplexed our forefathers, and is still giving us some study to-day. Although it would appear that, during the reign of Augustus, about 40 A.D., the first water wheels were made and used by the Romans, the scientific development of the water wheel appears to have been left until the present era, for until within the last few years, comparatively, the only devices used to convert the kinetic energy of streams into effective mechanical energy were the various forms of undershot and overshot wheels.

Crude as were these instruments, they have played a most important part in the world's history, for they have done much to develop countries with natural resources. Manufacturers who sought cheap power adopted the "wheels" available and located their plants along favorable streams, where these crude transformers of energy were made to grind corn, saw wood, make cloth, etc.

The inventors of the present century awakened to the necessity of improvement and have provided the present types of wheels. To their higher perfection and adaptability is due the fact that almost every power producing stream in settled districts of the civilized world is utilized.

The harnessing of water powers is not an easy task, but requires a great deal of thought, scheming, trying and fitting by the engineer. The records of the stream have to be looked up and studied into, with reference to high and low water, during a period covering many years, and due provision made for getting rid of the maximum flood of every season.

The possible storage capacity must be looked after, for oftentimes by a little forethought and a comparatively slight additional expenditure, a stream that naturally gets very dry at certain seasons can be made, by properly arranged storage, to give a practically constant output the year round.

Again, by carefully arranging the surrounding conditions, a stream may be made to give for a comparatively short period, when power may especially demand, double or triple its normal output capacity.

Probably one of the most important things to study, especially in localities subject to severe winters, is the question of frazile or anchor ice. This is a condition which has caused hundreds of thousands of dollars to be spent, either from the lack of knowledge or want of forethought; in some cases the conditions have been such as to make it almost impossible to successfully cope with them, without expending such sums of money as to practically ruin the enterprise. To overcome it successfully, the only way seems to be to provide a large pond of still water, extending to as great a distance as possible, even several miles, if attainable.

Many other details must also be studied before determining the best location of the water motor power house, so as to obtain the greatest available head with the least expenditure. In the study of the question the natural conditions of the soil, water and climate, all have an important bearing, on not only the engineering success, but also on the financial success of the enterprise.

As water falls cannot themselves be moved from one place to another, manufacturers have had to locate the sites of their plants at the falls. In many cases it is necessary, and in nearly every instance very desirable, that the power be transmitted to a certain distance. When the distance has been comparatively short it has been accomplished by belting, gears and line shafts, but when the distance extends beyond a few hundred feet, this system becomes so inefficient, expensive or impracticable that some other way has to be found.

Rope transmission has been used quite successfully, even to a distance of a mile, and in a few instances over that distance, but as the best practical efficiency is not

over 60%, and the first cost, as well as maintenance, is usually very high, this system has not yet been so successful as to command its adoption very extensively.

Compressed air has also been used for the transmission of energy with some success, more particularly in Paris, where there is a large plant still in existence; but here again the engineering cost has been great, efficiencies low, and maintenance high, and consequently, like the rope transmission system, has not met with general use and practice.

The electric dynamo and motor have given an entirely different aspect to the transmission of energy. Although invented in the early part of this century, it is, however, only within the last few years that the electric dynamo and motor have been developed practically and commercially.

The success and high efficiency attained by electric transmission of energy is such that the "water fall" is gaining prominence as a source of energy.

The pioneer work in electrical transmission was done with direct current system, and too much credit cannot be given for achievements attained. However, although in a few instances the distance transmitted by the direct current system has been up to twelve miles, yet, on the whole, for commercial reasons it has not been desirable to transmit power by direct current to a distance of over two miles, and even the advisability of this is looked upon to-day doubtfully. The reason for this is not because of the inability to transmit the power effectively, but because of the inadaptability of direct current apparatus for use at high voltages. The construction of direct current machines is such, having, as they do, so many auxiliary parts, that at high voltages they are very liable to break down, especially at the commutator and armature cores, except with very costly construction, and even then they are not at all sure; at high voltages the brushes are liable to spark and cause trouble at the commutator; and as the high tension parts require continual attention and adjustment while the machines are in motion, they are dangerous to the attendants.

Probably, however, one of the most important reasons for the inadaptability of direct current machines for long distance transmission at high voltages, is the inability to reduce the voltage to that at which it would be safe to operate at the place of consumption without the use of expensive and cumbersome as well as inefficient banks of motors. Such motors of high voltages, having parts under high tension, which require attention and adjustment while in motion, could not or rather should not be used except under the care of expensive special experts in every separate mill or factory where such motors were installed. To place them in the care of uneducated men would be unwise, and, in fact, foolhardy.

The highest voltage that D.C. apparatus can be wound for, commercially and safely, seems to be, as universally adopted, from 500 to 600 volts. The reason that power at this voltage cannot be transmitted great distances is purely a commercial one. There is no electrical reason why power by the means of direct current might not be transmitted to an indefinite distance, entirely effectively and successfully.

The amount of copper required for the transmission of power is directly proportionate to the amount of power to be transmitted, and also directly proportionate to the square of the distance for a given efficiency. This may be stated commercially by the amount of copper required for transmitting, say, 100 h.p. for both one and ten miles, the loss in transmission to be 8% and the voltage to be 500 volts.

For each leg of a one mile circuit there would be required two No. 0000 wires, or four No. 0000 wires, each one mile long, weighing 15,312 pounds, which at 15 cents per pound would cost \$2,300. For each leg of the ten mile line there would be required twenty No. 0000 wires or forty No. 0000 wires, each ten miles long, weighing 1,531,200 pounds, which at 15 cents per pound would cost \$230,000; or the power would cost, at 10% interest and depreciation on copper alone, \$2.30 per h.p. annum in the first instance, and \$230 per h.p. annum in the second case.

If, however, the voltage be raised to 5,000 volts, and be used for transmitting 100 h.p. for ten miles, the condition would be entirely different, for instead of forty No. 0000 wires, each ten miles long, there would be required for each leg but one No. 4 or two No. 4 wires each ten miles long, weighing 15,300 pounds, which at 15 cents per pound would cost \$2,300, or the same as transmitting the same amount of energy only one mile at 500 volts.

From the above it will be seen that the transmission of power at 500 volts is not entirely prohibitive for short distances, but as the distance increases it becomes one of vital importance, for the cost of copper is not the only item of expense then to be considered; the pole line itself becomes a very grave matter, especially when we have to consider the weight of forty No. 0000 wires, as in the example for only 100 h.p., and the cost becomes one that investors cannot afford, for the reason that power can be obtained cheaper from other sources, so that commercial transmission of power long distances by direct current at practical voltages is not practicable.

Although, as stated before, considerably higher voltage than 500 volts has been used with some success, as at Brescia, the number of such plants are very few.

It is a noteworthy fact that on this continent, where the transmission of energy is further advanced than anywhere else, there is not a single plant of any prominence that is transmitting energy by high tension direct current system.

It may be interesting to know that three or four years ago, when the Chambly plant was first discussed, a European firm planned out and tendered for the construction of that plant for transmitting the energy by means of this high tension direct current system, but, for reasons as above discussed, that system was not adopted.

How to meet the problem of long distance transmission, commercially and efficiently, has been left almost entirely to the alternating current system.

Alternating currents were known about the same time as direct currents, or about 1831, and were explained to the world by the great Faraday, who at that time discovered the elementary principles. From that time on, experiments were made by different inventors on induction coils, but no material progress was attained until May 22nd, 1877, when Jablotchkoff obtained British patents for "a new process of producing and dividing the electric light and apparatus therefor."

There were also other inventors at about this time who produced "improved induction coils on secondary generators," as some of them were called, but all seemed to have the idea that they could be operated with their primary coils connected in series, and that their secondaries could be independently controlled.

In 1878 a J. B. Fuller, of New York, suggested a system of using induction coils or transformers in parallel, but no practical results seemed to have been obtained in this direction until 1882, when Messrs. Goulard and Gibbs exhibited two induction coils at the Electrical Exhibition held in Westminster Aquarium in London, which ran in operation from the Siemens alternator.

In the autumn of 1884, Messrs. Goulard and Gibbs gave another exhibition at Turin. In this case, the primary circuit was nearly 50 miles in length. A series of transformers were placed on this line, one being in the Exhibition Building, one at the Turin Railway Station at Verine Riesla; another at Lanzo, a small village in the Alps of Savoy; incandescent and arc lamps were supplied at the various places.

The first parallel system that was started on this continent was by Wm. Stanley, Jr., in 1884, in the small town of Great Barrington, Mass., where light was supplied throughout the town by means of a parallel alternating current transformer system. From about this time commenced the era of alternating currents, although as far back as 1849 alternating current generators were devised.

Commencing with 1885 the alternating current system made great strides.

To employ waterfalls as sources of cheap power, high potentials became necessary. For these conditions the A. C. was especially effective; the ability to step up from low

potentials to high, and thus transmit power to a given distance, then to step down to safe and convenient voltages, entirely effectively, conveniently and without the use of cumbrous and expensive apparatus, rendered the transportation of the energy of water powers feasible and commercial.

Probably one of the first high voltage transmission experiments on this continent was in December 1891, and in January and February, 1892, at Pittsfield, Mass., at which test the writer had the pleasure of participating. The potential used was approximately 15,000 volts. A transmission line about a mile in length was built in an open lot a little ways out of town, where a small experimental station was built. The current was received from the local Electric Light Co. at 1000 volts, raised to about 16,000, sent out on the line, and thence returned, again lowered, first to 1000 volts, and then again to 100 volts, at which voltage energy was consumed in water rheostats. On the line experiments were made with porcelain insulators, as well as the oil type of insulators.

At this time, of course, comparatively little was known about electric current at this potential, so that everything had to be handled with gloves, as it were. The experiment proved to be not only useful and satisfactory, but highly successful, and gave considerable encouragement.

Although experiments were commenced, and discoveries made pointing to the advancement of A. C. motors in 1879, still practical results of any real value were not obtained until in the year 1890 to 1891, when the poly-phase systems were introduced. From that time it can be truly said that water powers could be utilized for the general distribution of power at distant localities.

One of the first and most notable exhibitions of this kind was made at the celebrated Frankfort Exposition in 1891, which proved not only interesting to the town of Frankfort, but to the world at large, for it taught lessons and set aside errors that would have taken years of toil and hard labor to have done otherwise.

Poly-phase generators having a total capacity of 300 h.p. were installed at Lauffen and operated by water power. From these, the current was transmitted a distance of 110 miles to Frankfort; several voltages were tried on the transmission line during the experiment, the highest of which was 31,000 volts; in the exhibition grounds were arc and incandescent lamps and small alternating current motors, all provided with current from the hitherto "wasted energy" of the streams of Lauffen, and with a loss of efficiency in the line of not more than 25%, which, at that time, was certainly a most noteworthy accomplishment.

During the next two or three years manufacturers spent a great deal of time and energy in perfecting their systems. The induction motor has been perfected to that of an ideal, and the usefulness and necessity of synchronous motors have been established.

For a few years following 1891, an occasional poly-phase plant was put up in different parts of the world. They were subjected to all sorts and kinds of trials, depending upon the character of the work to be performed at each individual installation, and although there was often much cold water thrown upon them at the start, and obstacles placed in their way, still they always came out ahead and proved a success, not only from the engineering point of view, but to the financial backers.

When we stop to consider that it has been only within the past six or seven years that a complete system has been devised for the utilization of distant water powers, and that all of the important transmission plants have been put in during that time, it is no wonder that there are yet some sceptics. But perhaps worse for healthful commercial developments are those who make a wild rush for some transmission scheme, without first considering all of its surrounding conditions, thinking that because someone else has made a certain project successful, their project must be also. It falls upon the engineer to bring the sceptic to lines of true reasoning and to teach him facts in their true light, so that he will see and believe, that with such resources at

his command, great things are possible; the engineer must also hold the enthusiast in check and prevent waste of money in impracticable undertakings.

The primary or fundamental question is to ascertain the point at which transmission of water powers will be a source of profit to the investor.

Many people think that because water strictly follows certain given laws of nature, and in doing so continually and constantly exerts energy, therefore the energy obtained thereby costs nothing.

People with such ideas are fortunately gradually growing less as time progresses, although the engineer often encounters men who have a few hundred h.p., or often times when the true facts present themselves, only 25 or 50 h.p., that they wish to transmit 5 or even 10 miles, in hopes of making vast sums of money by the use of this transmitted power in some small town for lighting and power.

The cost of electrically transmitted power is represented by the interest on the capital invested; the depreciation; the maintenance; the operating expenses and numerous other small contingencies, and besides, in some cases, the amount of money that has to be expended for water and land privileges. The sum of these accounts per year, divided by the amount of h.p. actually sold, will be the actual cost per h.p. for the case in question.

Probably the greatest competitor to electric power is steam power. In a few instances, power derived from gas or petroleum engines may also compete. The cost of producing steam power in any given locality is a fair criterion by which to determine how much electric power should cost. The cost of power produced from other sources can usually be disregarded.

The cost at which steam power can be produced in a given locality being ascertained, it can be determined what cost per h.p. may be expended on the construction of an electrical transmission plant to make it profitable to the investor, provided again a sufficient market can be obtained for power.

When electrically transmitted power does not cost more than \$100 to \$140 per h.p. installed, the investment is apt to be a profitable one, providing, of course, it is properly managed.

But what should it cost to harness and utilize water powers? This is a question that has to be figured out for each individual case, for there are hardly two plants where exactly the same conditions exist.

The first item of expense is amount required for water privileges. In some cases this is rather an unimportant consideration, while in others it is the chief expenditure, for it may involve the buying of thousands of acres of land surrounding the stream, because the necessary dams may cause to be submerged a great deal of valuable land, or large tracts have to be bought for building storage reservoirs, or the right of way for pipe lines, etc., have to be secured.

When land is cheap, these considerations are often not objectionable, but where good farming land, or land valuable for other reasons, has to be thrown to waste, the question is often a perplexing one.

The cost of the dam, power house and hydraulic machinery is, as a rule, dependent almost entirely on the characteristics of the stream being utilized. Entering into the question is the amount of water in the stream, both under normal as well as abnormal conditions at various seasons of the year; also the head or fall and whether it is dependent on natural conditions or requires the building of large dams.

Generally speaking, other things remaining equal, generating plants, comprising the power house, hydraulic and electric machinery, as a whole cost less as the head increases, until certain limits have been reached.

When the head is low, as ranging from 4 to 10 feet, it requires a comparatively large wheel for a relatively small amount of power, and then slow speeds can only be attained. Where large units are desirable, a number of these wheels must be coupled together in order to get the required power. The speed attainable can be raised or lowered to a certain extent, depending on the size of the wheel. If higher speeds at low heads be desired for large units, many wheels must be operated together, requiring not only a great deal of

room, and consequently larger power house, but considerable line shafting, gears, couplings, etc., which not only increase the initial cost, but increase expenditure of operation and maintenance of the plant, as well as introducing another source of inefficiency.

With higher heads a larger amount of power can be obtained from fewer and smaller wheels with higher speeds, and, therefore, cheaper generating apparatus.

The cost of generating apparatus for a given capacity, other things remaining equal, is almost directly proportional to the speed at which it runs, and for this reason it is always desirable to refrain from too low speeds wherever possible.

There are many people who are imbued with the idea that it is impossible to build a modern station without direct connecting all of their apparatus, and that belting at no time should be used.

Although direct connection is desirable, still it must not be carried to extremes.

A good engineer will hardly warrant the expenditure of, say, \$15,000 for a 300 k.w. generator to run at a speed of say 75 to 100 r.p.m., when a machine just as good in every respect, and sometimes better (because it is a standard size), can be bought in belted units for \$5,000. Yet this is sometimes done, burdening the plant with many thousands of dollars on which it has to pay money, for no other reason than that "so-and-so's plant is direct connected and I want a plant just as nice and good as his, and belts are always an awful nuisance."

As stated before, direct connected units are always desirable where conditions will warrant them, still it must be borne in mind that belts have been in successful operation now for a good many years, and there are many instances where the maintenance of them has not cost 1% per annum, and although their use involves a loss of efficiency of somewhere between 2 and 3 per cent. at times of full load, still this loss in a water power plant is not a critical amount, and in fact is almost always inappreciable.

The next item of considerable expense is the transmission line—always rather an uncertain item, on account of its variations in cost for different distances and the conditions of local distribution.

The poles, with their appurtenances, exclusive of wire, will cost between \$250 to \$500 per mile, varying according to circumstances.

Rights of way for the placing of poles may often be expensive.

The transmission wire must be considered separately.

Reference has been made earlier herein to the voltage or size of wire. The voltage at which it is practicable to run now-a-days is reaching vast proportions. There are two or three plants being installed in which 20,000 to 22,500 volts will be used, and a plant is likely to be installed soon that will use 60,000 volts.

The use of high voltages in the past has been limited greatly by the insulators. The glass insulator has proven itself insufficient for most climatic conditions. The oil type of insulators was introduced some years ago, and a great deal expected from them. They did give excellent results in the laboratory, but unfortunately the oil evaporates, and the impracticability of renewing the oil, especially when the line is in use, soon put them in disfavor.

Porcelain insulators appear to have solved the problem. The trouble at first was to get them properly vitrified, but this difficulty seems now to be overcome, and the insulators have proven all that can be desired when used with the usual voltages now employed. As to whether they will successfully cope with the higher voltages now contemplated is a question yet to be answered.

The cost of the transmission wire is often the most important part, but is always different with each case, dependent, as it is, upon the amount of power to be transmitted, the transmitting voltage, distance, and the allowable loss. As a whole, it is always best to keep the transmitting voltage as low as possible and still keep within commercial conditions. Many people are carried away with the idea that if they could only use high voltages the cost of transmitting would be reduced to a minimum.

It must be borne in mind that with the use of the higher

voltages the cost of insulators increases, the electrical apparatus necessarily costs more, and moreover, the risks are greater throughout the system, and consequently necessitates more skilled attendants to look after the plant.

All of these items have to be carefully considered before looking into the possible saving of copper on the line.

For mechanical reasons, a wire smaller than No. 6 B. & S. should not be used for line work. More cautious engineers will say it should not be smaller than No. 4 B. & S. It is foolish to attempt to use voltages which allow the use of smaller than No. 6 wire. Where a shut-down would mean heavy damages, it might be even advisable to use a wire not smaller than a No. 2 B. & S.

If these facts are always borne in mind, the question of voltage will often times adjust itself, and the use of very high voltages will not be found necessary unless the transmission be for especially long distances, and the amount of power particularly large.

The permissible drop is dependent upon the power obtainable at the generating station and the amount to be delivered at the end of the line. There are a few instances where power is scarce at both ends of the line, and where it is desirable for this reason to keep the loss of transmission as low as possible, but such cases as a rule are rare, and we are more often met with the reversed conditions.

To get good results electrically, the loss in the line should not be more than 15%. If it be more, it will, with the other losses that are necessary in the rest of the apparatus, especially where the load is liable to be a fluctuating one, render good service almost impossible.

The figuring of drop on transmission lines should always be left to competent engineers, for with A. C. the question in many instances is not a simple one, because it involves other conditions besides the ohmic drop. When alternating current is sent through a conductor, it has to deal not only with the electric resistance of the wire, but also with a resistance due to the fact that the electric magnetic stresses set up at any point of the conductor, create electromotive forces at other points of the same conductor, which oppose and retard the passage of the current, or in some cases, tend to shove it ahead.

As to how far power can be transmitted, the engineer can conscientiously say to an indefinite distance, and he would be fully prepared to figure out, and contract for, if necessary, the fulfilment of his statement, but it rests with the commercial men to cry halt. The distances attainable, however, on a profitable basis, have been growing greater from year to year, as the manufacturers have been prepared to extend the limit to which they are willing to build high tension apparatus. At present it would appear that where the distance to be transmitted is over 75 to 100 miles, no matter how cheap the hydraulic development, commercial competition is not practicable with existing power where coal can be obtained for \$2.00, \$3.00 or even \$4.00 per ton.

The step-down station and the distribution of power are the next items of expense, including the cost of the necessary switchboards, transformers, &c.

The location of the step-down station and the method of the distribution of power constitute a very important question. Unfortunately, very often this subject is entirely omitted or overlooked by the promoter, but is one to which should be given considerable thought.

The step-down station itself should be centrally located, so as to make the distributing lines as short as possible.

It is not generally advisable that transmission lines of very high voltages and large currents be extended through thickly settled communities where they might be liable to disturbance from fire or accidents of similar character, in the immediate locality of the line. In some places, to enable the distribution station to be centrally located, transmission wires are placed in conduits under ground, when they pass through thickly settled districts so as to avoid the danger that would otherwise exist, but this, of course, is expensive construction, and the cost of it must always be balanced against the advantages of having the step-down station centrally located, as against its being placed at the outskirts of the town.

All the various items require careful study to obtain least cost and avoid unwise economies.

When all these various factors have been properly

adjusted and the resulting condition of the water power electric plant is that the power available twenty-four hours every day is at or about the cost of steam power in any given locality, the future profitable operation will be, no doubt, assured, because the popularity of electric power is not due alone to the fact that it can be produced cheaper than power obtained from other sources, but also to its superiority in other directions. This is evidenced by the fact that in mills and factories, where both sources of power have been tried, electric power is displacing the steam plant. Owners having experience with both invariably state that they would not be willing to return to their former power plants, even if power could be produced as cheap or cheaper than they are now obtaining it for electrically. The reasons for this are very numerous. The power is always on tap day and night, year in and year out; there is no waiting for boilers to be fired, nor shut-downs on account of strikes at some distant coal field; less room is required, and consequently floor space formerly occupied by belts and shafing can now be utilized for manufacturing purposes; also electric power can be easily sub-divided into any number or sizes of units, and thus independent departments and machinery can be worked separately instead of from one big unit.

Overtime work in any department is much cheaper, for by having departments separately operated they can be run independently at will, without running all the other machinery in the mill. The fire risks are less, and rates of insurance less for mills operated electrically than by other means.

Removal of so many belts, line shafts, pulleys, etc., secures less danger to life of mill employees, and the mill is lighter and cleaner, and consequently the health of operatives better.

On account of the extreme simplicity of the A. C. electric apparatus, anybody with ordinary intelligence can start it in motion, and thus avoid depending on one or two men.

Moreover, with electric power it is possible to maintain a closer speed, which in many instances enables the turning out of a larger quantity of better product commanding higher price; and so on for most every department and branch of business, some advantage is gained without anything lost.

All of these advantages are not evident to the consumer before or when he first puts in electric power, and he often refuses to listen to them, thinking that they are entirely imaginary, but a short experience brings the conclusion that electric power is "cheap at any price."

It may be interesting to note here that there is a project now on foot in which it is contemplated to transmit 30,000 h.p. a distance of between 30 to 40 miles; the transmitted power to be used in mills now operated through shafts, gears and belting by water wheels, because of the advantages to be gained by using electric power.

The use of electric power is not confined to driving machinery in mills or factories, for it is fast finding its usefulness in other directions. The use for "electro chemical" enterprises is fast reaching vast proportions, and there are plans now on foot for the utilization of at least 150,000 h.p. in this way during the next two or three years.

There are many thousands of h.p. being used in the street railways, while the big trunk lines are seriously considering its use, and are continually asking the manufacturing companies for plans and estimates.

Then there is the electric welding, the electric plating, the supplying of energy to horseless carriages and electric launches, to say nothing of the hundreds of thousands of incandescent and arc lamps that are used for general lighting.

The utilization of the water power by electric transmission has not stopped with the commercial world, but has forced itself into the privacy of our own homes, not merely with incandescent lamps, but with electric cooking utensils, smoothing irons, electric heaters, fan motors, etc.

What would our forefathers say if they were told that to-day we are depending on such and such a river, so many miles distant, to cook our meals for us and to have our boiled shirts laundered; but we would better not laugh now, for the coming generations may have as much occasion to laugh at us.

HOW TO OVERCOME SOME OF THE DIFFICULTIES ENCOUNTERED BY CENTRAL STATION MEN.

By A. A. WRIGHT, Renfrew, Ont.

IN treating this subject I shall do so from the standpoint of one who has to deal with customers living in a town of moderate size, and not from that of the owner of a plant in a large and populous city, because the circumstances would be, in many respects, quite different, and the requirements, as well as the mode of arranging the service, would be altogether different. I shall take it for granted that the central station is equipped with an arc and incandescent plant, that the proprietor not only does commercial lighting, but supplies light to the corporation as well.

1st. Let us take up arc lighting on the streets. This brings us at once into contact with the corporate fathers, many of whom know nothing of arc lighting, except that it is not only necessary, but their special duty, to appear wise in order that they may look well after the interests of the town.

And now let me make my first suggestion, and that is, that you leave municipal politics entirely alone. If you have an inordinate craving after politics, which you have not the power to restrain, let your light shine before the throne of the Legislative Assembly or in the chamber of the House of Commons, but restrain yourself from meddling with municipal politics, lest you make to yourself enemies who will be sure to avenge themselves, sooner or later, in crippling your lighting contracts with the corporation. I do not wish you to infer from this that you should not exercise your franchise when the day for voting comes around, but on the contrary, let it be known that you and your employees always vote for the progressive and enterprising men of the town and as every aspiring alderman will want your assistance, you if you do not make too much noise, will generally manage when he is elected to get his. Be careful not to make political enemies but to have as many of the town authorities with you as you possibly can. In most towns the contracts for street lighting are made annually, and not as in cities, for a term of years. See to it then, that your contract is so arranged that it shall terminate on the 1st of March. You can do this by informing the proper authorities that your books are so arranged that your Electric Light year begins on that date. Then see that the following harmless looking saving clause is inserted near the closing part of the contract. "And it is further agreed that either party may terminate this lease at the end of its term by giving the other thirty days notice in writing prior thereto and in default of such notice this agreement shall continue in force after the termination thereof, for one year, and upon the same terms and conditions as are herein expressed and in like manner thereafter, unless such notice is given at least thirty days before the corresponding date in each succeeding year, a like renewal and extension of this lease from year to year shall be considered as made and executed by and between, the parties hereto." Furthermore have your payments fall due quarterly and on the 1st of March, June, September and December. You know that in Ontario at least, our Municipal Elections are held at the beginning of the year, and as most of the Aldermen will be aspiring to re-election, and would like to have your assistance to re-elect them, they will quite naturally forget, as the term of their holding office is drawing to a close, to give notice of the desirability of terminating that contract, and you almost invariably escape that threatened danger from the outgoing council. Then the new council does not assemble till the last of January and as very little business is done at the first meeting and many of the members are new ones, Electric Lighting is not thought of till your quarterly account is presented in March when it will be too late to give the required notice, and so your contract runs on, in this manner from year to year, renewing itself without any trouble whatever. Another difficulty, which you are almost sure to encounter, is the height of the poles on which your lights are placed on the streets. Some will want soft. poles some 75 ft. and some even higher than either of these. When your contract is made be sure and have the clause worded in this way. "That the hangers from which the lamps are suspended shall be — feet from the natural level of the surface of the ground at the foot of the pole," and not, that the lamp, shall be so many feet high, as you will notice that this makes an important difference in your favor. It is well to have it so arranged that you need not run your arc plant on moonlight nights, not merely on account of the direct saving that there is in this, but it sometimes is very convenient, if there are accidents, in giving you an opportunity to make needed repairs.

And now as to your commercial lights. Have your contracts made with your customers on a yearly basis, with same renewing clause that there is in your contract with the town, but with this difference, that the payments in this case be made to you weekly, and then see to it, that you make your collections in this way, for a man will frequently pay you a small sum weekly, when he would not pay the same amount if paid quarterly. It may not be amiss to mention that in all these contracts, when stating the candle power of the lamps you are to furnish, that you should be sure and employ the words "nominal candle" power, as it may save you under certain circumstances no small amount of trouble also.

And next, as to your incandescent service. This will, of course, be largely, if not entirely, a commercial service. You will have all manner of people to deal with, and you may expect, in many cases, to have your patience sorely tried.

Then to begin at the beginning. Never under any circumstances do free wiring. By that I mean that you should never undertake to wire a house for nothing, in order that you might thus get a customer for your current. Of course you should do all primary work as low as possible, but not at a loss. If your power is at all limited, or if you run by steam, you will find, in my opinion, that you will make more by running your lights on the meter system than you will by giving a flat rate, unless you get an exceptionally good price for them.

I understand that in many places it is customary to take the readings of your meters quarterly, as it thus saves a good deal of time in taking the readings, making out the accounts, collecting them, etc. In this, as in other things, the old adage holds good that "Short accounts make long friends," and by no means should you allow your accounts to pass more than one month without being rendered, and, if possible, collected. It might not be so bad, in the short nights of midsummer, if quarterly collections were adopted, but in the end it will amply repay you to take your readings on the first day of each month, and make your collections on the 2nd.

And now as to the location of your meters. We were instructed when installing our plant to locate them in some out-of-the-way place, where they would not be seen, and high up, so that they would not be meddled with. Now this may all be very good advice in its way, but my advice to you is, not of course to put it in the parlor, or in such a place as to cause it to be an objectionable feature in the household, but, be sure and place it low enough, that your man can get at it with as little trouble as possible, and also in a place where there is an abundance of light, so that the readings may not only be taken quickly, but accurately. When you have a large number of readings taken monthly, it becomes a matter of some moment that meters be so arranged that the work can be done quickly and accurately as well. You will be frequently told by your customers that the meter is wrong—that they know they never burned that amount of current. In such pronounced cases as these, when the assertions are very strong, I find it is better at once to say, "Well, it is possible as you say that there is something wrong; you know we are none of us infallible; we will see and have a second reading made at once," and look into the matter and at once, do as you have promised, no matter though you feel almost sure that it is all right. You may find that there is an error, and if so you should of course immediately see that it is corrected, but if you find that the reading is correct, and that Mrs. Julius Caesar still insists that that meter is no good, and declares that the thing runs whether there are any lamps on or not, and tells you in a most emphatic manner that she can hear the thing sing like a rattlesnake, lights or no lights, and she knows that it runs on wheels, what then? Above all things do not allow yourself to answer back harshly, for doubtless she really is sincere in her protestations, and it is not wise to contradict her too rashly. I have found a good remedy in replying that of course it is just possible that the meter is not absolutely correct, but that you feel quite confident that it is, and that to cover just such cases as these the government has appointed an electrical expert, to whom both parties can appeal, and if she, after considering the matter over, still thinks there is something wrong, that you will write and have the inspector come up and examine the meter, and if he finds it wrong, that you will bear all the expenses connected with the inspection, but if it is correct that she is to bear all expenses. Tell her just to think the matter over and let you know, and so far as my experience goes that ends the matter.

Another difficulty that you will doubtless meet when running on the meter system is in having your customers send out of town for 5 c.p. lamps and when only one of these is used your meter will not respond. This you will easily discern when at the end of the month you perceive that no current has been consumed, and I may just here mention that this is another reason for taking your readings monthly instead of quarterly. Such cases are not numerous, yet they do turn up where the family is small and its members are contented to do with a minimum of light. This difficulty can also largely be overcome by making a minimum rate of say 50 or 75 cents per month, which amount can be arranged according as the circumstances of the case may require.

There are of course many other difficulties that central station men have to deal with, but it is impossible to consider many in an article of ordinary length and the remaining ones will be left for others to treat with, as they, in their wisdom, may see fit.

THE IMPORTANCE OF PROPER METHODS OF ILLUMINATION.

By F. A. BOWMAN, A.I.E.E., New Glasgow, N.S.

IN the last few years, since the electricity supply business has got beyond the stage of "systems" and controlling patents, there has been accumulated a great deal of most valuable information in regard to improvements in the generating and distributing plant, and to the best methods of realizing in practice the benefits from these improvements. From time to time there have arisen most animated discussions on the best system of rates, and methods of charging for the use of the current. The keynote of these discussions is the fact, brought to light by the accumulated experience of those companies that have been supplying electricity for some years, that the fixed charges grow steadily with the maximum demand on the plant, and that therefore the customers should be educated to use the current as many hours per day as possible. This is a matter of the most vital importance, and every central station man in this Association should procure a copy of Mr. Arthur Wright's paper on "The Profitable Extension of Electricity Supply Stations," read before the National Electric Light Association at Niagara last year, and also one on the "Cost of Electricity Supply" read by him before the Municipal Electrical Association in England, and to study them until he knows them by heart.

It should be distinctly borne in mind, especially by the smaller companies, that to do a growing and really successful business, something more is necessary than to merely induce your customer to put in so many lamps and then to get as much pay as you can from him for them. It is now clearly demonstrated beyond a peradventure that the margin of profit is as narrow in the central station business as in any other, if not a great deal narrower, and that even when there is no competition from gas or a rival company the closest economy and best management

are necessary to yield a profit to the shareholders and provide for future contingencies. In view of this the manager should realize that he must educate his clientele and give them the best satisfaction in every way. Too many managers are satisfied when they have succeeded in persuading a customer to take a certain number of lights. If in addition they are giving full pressure at the lamps and a reliable service they consider that their duty to both the company and the public is done. Now, this is a wrong principle. Attention should be paid to the purpose for which the light is required. Take for example a shop. The purpose for which it is to be used, its size, the height of ceiling, finish of the walls, kinds of goods to be displayed and sold, arrangement of counters and show-cases—all must be noted and considered. It is useless to attempt to light a modern drug store and a ready-made clothing store in the same way, and expect equally satisfactory results in both cases. The manager should be looked upon as an authority on methods of lighting, and if he gives the matter a reasonable amount of attention he very soon will be. He must remember that he is a dealer in light, and to be a successful one must know all about it—how it is best used and what are the latest fashions in it. If you go to a tailor for a suit of clothes you expect him not only to sell you the cloth and to make up the suit so that it will fit you fairly well, but you expect him to be able to tell you what are the latest styles and fashions and which of them are best adapted to the purpose for which you want them. Some managers will say, "Oh, I have a class of customers who do not care about fitting up nicely and will not spend money on it. All they want is that I will run the wires in and hang the lamps on cords as cheaply as possible." This man is mistaken. There is no community that will take electric light at all where a decided amount of education cannot be carried out. Education of his customers is a very material part of the work of every successful manager in the electrical business, and is one of the principal reasons why the business cannot be properly carried on by some one who has a number of other interests to look after as well. The manager must study this question of proper illumination so as to master the main principles necessary to a clear understanding of it. He must study his customers so as to know what their tastes and requirements are. He must carefully watch the advertisements in the technical journals and the catalogues that are so plentifully distributed, and many of which contain accurate and valuable information, and then correspond with the advertisers to see if the articles that strike him as suited to some of his customers can be brought within their reach. Then he must canvass carefully and patiently, and if he fails one year must try again the next, because by that time he will know better how to work, his customers' ideas will have advanced somewhat, possibly prices will have dropped a little. The net result of all this is that he at last secures a contract for fitting up that is a pleasure to him to undertake and gives eminent satisfaction to the customer when done.

When first installing lights in the smaller towns and villages cheap, but not poor, work must be done to get the light introduced, but it should be looked upon as introductory only, and later on an earnest and continued effort be made to weed it all out.

A very common case that arises is that of a customer occupying a shop who is always making trouble about the bills. He has a certain number of lights strewed about without any definite arrangement, one switch to shut off the whole thing when he leaves, no shades, no reflectors, and the shop is half dark when all the lights are on, and if he is on meter and turns off a few to save money he has not light enough to do his work. The result is he is constantly growling himself and making others do the same.

When a case of this kind comes up the manager should go to him and suggest that by rearranging things he can have better satisfaction for less money, talk the matter over and work out a scheme that will put the light just where it is wanted, and add a few switches so that the groups of lights can be readily turned on and off. After the exercise of considerable tact and unlimited patience the customer will begin to be convinced and finally consent to refit. When this is done and the lights placed just where wanted, very possibly lamps of smaller candle power than before can be used on some of them. The result is a well lighted shop, which is a good advertisement for both the customer and company at a somewhat reduced cost to the customer and satisfaction all round.

The fewer lights the customer can install and yet get satisfaction from, the longer hours he will burn them all, and so tend to smooth off the peak of his individual load line. And the cheaper he can do it while still yielding a profit, the better for the company, as he is an advertisement and attracts others. Five customers each of whom has ten lights and uses them all three or four hours each night, are better than one with fifty lights who uses them all for one hour and then turns off as many as possible.

It must be clearly borne in mind that the candle power of a lamp and the amount of illumination we get from it are two entirely distinct things. The useful illumination is the amount of light reflected back to the eye by the objects on which the light falls, and the quantity and quality of the light so reflected is the important and controlling factor, not the candle power of the source of light. The unit of illumination is the "candle-foot;" that is, a light of one candle power one foot distant from the object to be illuminated. This is a comfortable light for reading. The illumination is given by the formula:

$$\frac{\text{Candle power}}{\text{Distance in feet}^2}$$

Thus a 16 candle power lamp 4 feet away gives 1 candle foot of illumination.

The illumination yielded by a certain lamp can be very materially increased by the use of reflectors. The illumination of an object which when below a small light is 1 can be increased to 23 by a paper reflector, to 30 by a white glass one, to 64 by a polished one, and to 260 by a silvered glass hemispherical one. White reflectors throw a very nice soft light and smooth off the edges of the shadows so as to produce a very pleasing effect. In using them it should be remembered that the ordinary law of reflection of light, viz., that the angle of reflection is equal to the angle of incidence does not apply to them; but that the rays of light at whatever angle they may strike the reflector spring off from it in lines perpendicular to its surface. Consequently there should be no attempt at the mathematical shapes of optical re-

flectors, but large flat surfaces must be used. They should always be painted a dead white. The enamelling of reflectors to have a shiny surface is a mistake; they do not give as good an effect to begin with and even the best rapidly lose their gloss.

The following table, due to Dr. Sumpner, gives the reflecting power of various surfaces and shows what a wide variation in the number of lights required for a given illumination may be caused by a change of interior decoration:

White blotting paper.....	82 per cent.
Ordinary foolscap.....	70 "
Newspapers.....	50-70 "
Yellow wall paper.....	40 "
Blue paper.....	25 "
Dark brown paper.....	13 "
Dark chocolate paper.....	4 "
Plain deal (clean).....	40-50 "
" (dirty).....	20 "
Yellow painted wall (clean)....	40 "
" " (dirty).....	20 "
Black cloth.....	1.2 "
Black velvet.....	4 "

When studying out the lighting of a given place we must consider whether we merely wish for a general sense of the space being nicely or brilliantly lighted, as in a ball room or dining room; or whether particular spots or objects need to be clearly illuminated, as the goods in a shop or the tables in a library.

The most important step to good illumination is to secure to the utmost extent possible that no bright spots or lines of light shall strike the eye. The moment the eye sees the source of light it closes itself up for protection from the direct rays and consequently cannot receive as much of the light reflected from neighboring objects, and therefore does not see them distinctly. The following experiment will illustrate this very clearly: Take a shop with two show windows and hang the lights in one window about the level of the eyes, as is so commonly done, and in the other put the same number of lights in good reflectors close up to the ceiling. Now go across the street and note the result. In the first window the goods on exhibition are fairly well lighted, but it is a discomfort to look at them long and nothing is seen behind them. In the other window the goods are shown up beautifully and you can look at them as long as you wish and at the same time can see right back into the shop and see the goods on the shelves and counters.

In the smaller towns and in many cases in the larger ones the question of getting exactly the best illumination and effect from the lights must be subordinated to that of the cost both of the fitting up and of the current consumed. Also a certain amount of deference must be paid to the ideas of the owners.

Thus in lighting show windows the very best method is to light them from overhead, or from the corners, with lamps in deep and powerful reflectors that will throw the light directly on the goods to be shown and will shield it from everywhere else. If it is necessary for the proprietor to be as economical of light as possible this can hardly be done as these lamps are useless for general illumination in the shop. In such a case as this clusters under good flat reflectors on the ceiling of the window are best. These show the goods in the window very nicely, they make the front look much brighter, and at the same time throw a very considerable quantity of light into the front part of the shop where it is most required.

An exceedingly common case is a shop from 20 to 25 feet wide, 40 to 50 feet deep with two show windows, the ceiling being from 10 to 12 feet high, and used for dry goods, tailoring, groceries, etc. A very good arrangement for this is to put a three-light cluster and flat reflector in each window, and three similar three-light clusters down the centre of the shop. The main switch should be placed at a convenient spot near the door by which the employees enter and will of course turn on all the lights. Another switch should then be arranged to turn off the window lights, and another to turn off two lights in each of the clusters in the centre. This will be found to be a most convenient and economical arrangement for the customer, who can proportion his light to the weather and amount of business doing. While the central station man will find that, if the shop is open in the evenings at all, the whole of the lights will be on long enough to cover the maximum demand, or standing charges.

These clusters should not be more than 10' 6" from the floor; were these lights raised to 15 feet the direct light from them would be reduced one half, calling for double the number to produce the same illumination, but since in this case the reflection from the ceiling and walls would be somewhat increased, probably an increase of 50 per cent. in the number of lights would be sufficient.

Drug stores generally call for very special treatment, and the lighting must be made to harmonize with and to show off the fittings. Brackets on the top of the shelving and a handsome electrolier in the centre are generally very acceptable, but as the result desired is more in the way of brilliant effect than of mere illumination for the showing of goods each case must be studied out to suit the purse and the tastes of the persons concerned.

In the matter of churches the great desideratum is the even distribution of the light, with absence of shadows and the total avoidance of all spots or lines of light that will strike the eye of the congregation, or of the minister, especially during the sermon. The minister, the choir and the organist of course require plenty of light, and it often calls for considerable ingenuity to supply their needs without having a bank of lights most unpleasant to the congregation. If such a group of lights cannot be avoided it should be provided with a switch within convenient reach so that it can be turned out during the sermon. In Anglican and Roman Catholic churches which have chancels separated by an arch from the main body of the building, the lights can often be arranged on this arch so as to be entirely hidden from the congregation and yet throw a very pleasant light on the choir and reading desks.

Lodge rooms should be well lighted, and as they are often finished in very dark colors this is a difficult matter. The lights should be divided into groups controlled by switches, and those at the desks of secretary and treasurer are often wanted to be independent of the others in the room. A dimmer is a valuable addition and should be arranged to con-

trol all the lights except those just mentioned. It should be a regular theatre dimmer of ample capacity. Lodges are not as a rule paying customers because their use of the light is irregular and the income per light from them very small. Nevertheless it pays to give a good deal of attention to the fitting up of them, because many get educated to good lighting through them whom it would be difficult or impossible to reach in any other way. It will require a good deal of work to get the first one well done and especially to get the dimmer introduced, but after that it will be comparatively easy.

EXPERIENCES OF AN INSPECTOR.

By J. K. JOHNSTONE, Inspector of Electric Lights, Toronto.

WHEN honored by an invitation from the Executive to prepare a paper for the Society, I was somewhat in doubt as to the choice of a subject. I wished to furnish something that might be of interest to you and at the same time to avoid any of the important branches of electrical science which might leave me liable to criticism from gentlemen so highly qualified; hence, with your kind permission, I will confine myself to giving you a few impressions as received in my capacity as inspector.

At the introduction of the government inspection of electric lighting, there were a few, as you may remember, opposed to the act, and I acknowledge that it was with some misgivings that I went forth on my duties. However, it is with pleasure that I can now recall every visit made to the electric light stations in my district, and in every instance have I not only been kindly received, but every suggestion of improvement offered by me has been acted upon immediately and with evident pleasure. I need not tell you that in not one instance have I found any attempt on the part of electric light companies to defraud their customers, although occasionally appealed to by consumers on that ground. An investigation usually resulted in discovering old lamps, too few lights for the space lit, wastefulness where a meter was in use, or some other fault in the power of the consumer to correct.

The persistence of many purchasers of electric light in clinging to old and useless lamps is a common source of annoyance to the companies and a difficult matter to overcome. The old lamp is often expected to give as brilliant a light as when first installed, and when unable to do so the charge is frequently made that the company supply a too low voltage. To please these grumblers, a mistake is sometimes made in endeavoring to supply a current sufficient to brighten these worn-out lamps, and this, too, at the expense of new lamps, whose brilliancy is thus deteriorated. As it is impossible to compel the purchase of new lamps, and as the companies are anxious to please their customers, I have suggested, when consulted, that new lamps should be supplied at their actual cost, thus throwing the blame on the consumers when their lights were poor, economizing electric current and sparing new lamps.

The question as to the advisability of using meters, where practicable, can only be answered in their favor. By the employment of a meter a just system is accorded to manufacturer and consumer alike; the wasteful man is made to pay fairly for his neglect, while the careful and honest man is charged only for the light needed and current consumed. Under the flat rate system, it is not uncommon to see large shops brilliantly illuminated throughout the entire night. Managers tell me that it is difficult to introduce the meter where flat rates have been charged, but, despite the objections, many are making the change. The several types of dial registering meters which I have inspected are usually accurate, and I am told prove satisfactory as measuring instruments for either power or light.

A lack of uniformity in rates, both by meter and flat rate systems, has been a subject of complaint with some managers. There is evidently no remedy for this unless an arrangement can be arrived at by the manufacturers themselves and a standard charge agreed to.

In several towns in the district visited by me a system of street lighting by incandescent lamps has been adopted. When properly arranged the appearance is quite pretty and the light well distributed.

In concluding, permit me to tell you that the managers and electricians I have met in my work are without exception kindly and intelligent men, and in this favorable opinion I am borne out by other inspectors with whom I have spoken upon the subject. It has been suggested to me that there may be some potent and subtle charm in the electric current which develops the best qualities in a man's character. Can this be so?

THE UNCONSCIOUS OWNERSHIP OF AN IMPORTANT KEY.

A PLEA FOR THE INTRODUCTION OF GOODS TRAFFIC ON OUR SUBURBAN TRAMWAYS.

By W. T. BONNER, Montreal.

THE first consideration in exploiting any new suburban tramway is the possible or available passenger traffic. That being found inadequate to guarantee a fair return on the cost of installation and maintenance, the project is usually abandoned for the reason that only passenger traffic can be considered, owing to the high cost of handling goods traffic at the terminals. While a motor-man and conductor are sufficient to handle a two or three-car electric train for passenger traffic, with very little expenditure of time or assistance for loading and unloading, all railways under present systems require a large additional force to conduct the hundreds of details attending the reception, checking, loading, transferring, unloading and proper delivery, in good order, of either car lot or package freight.

It is not the railway investors alone who suffer the effects of this handicap, but the property owners also, since the latter have no recourse, while the capitalist has but to seek other more profitable fields for investment.

It may therefore be conceded that the whole subject presents two phases of commercial economy, viz.:

(a) From the standpoint of the agriculturalist and land owner; how best to provide a means for increasing the value of remote but otherwise valuable agricultural lands, and at the same time retain present value of adjacent property by converting it from market gardens into residence and manufacturing sites.

(b) From the standpoint of the capitalist and manager of railway properties; how best to increase the earning capacity of existing or proposed suburban lines.

DEPRECIATION OF FARM LAND VALUES.

With the ever increasing centralization of population and commerce, inaccessible property becomes less valuable; all land, whether barren or fertile, suffering alike, according to its distance from the centre of demand for farm products, which we call markets. Such distance is not always measured in actual miles, but rather in accessibility, since in our day we find frequent examples of the paradoxical long and short haul rates. The Minnesota and Manitoba farmers will deliver their wheat at the seaboard at a lower cost per bushel than the farmer who may live a hundred miles off the coast. The eastern farmer may have just as fertile land as his western competitor, but he is handicapped by having to haul his wheat forty or fifty miles over poor wagon roads to reach the nearest railroad.

In either case, the terminal charges, including the cost of loading the produce at the farm, is approximately the same, but the difference in cost of haulage per ton-mile by railroad and wagon road is so tremendously in favor of the former that without such facilities the farmer may as well retire from business. It has been stated as a fact that to transport a ton of coal from Buffalo to Chicago costs no more than to move the same quantity of coal across the sidewalk in either city.

In a late number of the Marine Review some interesting comparisons were made between the present cost of shipping coal to the Northwest and prices which obtained previous to the introduction of modern vessels and automatic coal handling machinery. Car-dump machines can now load four thousand tons in ten hours, as compared with two or three days under old methods; and coal is now carried from Lake Erie ports to the head of Lake Superior at twenty cents per ton, as against fifty cents, which was considered a ruinously low rate a few years ago.

It is frequently asserted that since the introduction and development of steam railways, they have gradually superseded the earlier methods of transportation and traffic, and as a consequence highways are no longer an indication of progress. This is true only to a limited extent. Railroads have changed the character of suburban traffic, and personal travel is no longer dependent upon the condition of the highways, but commercial intercourse, as represented in the exchange of products, is as much dependent upon the condition of the public road to-day as it ever was, for the reason that it is impossible to construct a railroad to the door of each producer and consumer. Hence railroads can never entirely supersede the common road, and every ton of freight carried by them must be conveyed over a highway at either or both terminals, and the cost of this highway transportation has a marked influence, not alone upon the price paid by the consumer, but also in the profit realized by the producer.

Few people have any knowledge of the real cost of transportation by horse and wagon, or comprehend the amount of money expended needlessly every year through failure to provide proper roadways and modern tramways.

The following table shows the results of actual observations on the cost of moving a load of one ton a distance of one mile on level roadways, with different pavements and under average conditions:

TABLE I.

COST OF TRANSPORTATION BY HORSES AND WAGONS PER TON-MILE ON DIFFERENT SURFACES.

Iron Rails.....	1.28	cents per ton-mile.
Asphalt.....	2.70	" "
Stone, paving, dry and in good order...	5.33	" "
" " ordinary condition.....	12.00	" "
" " covered with mud.....	21.30	" "
Broken Stone, dry and in good order...	8.00	" "
" " moist and in good order.	10.30	" "
" " ordinary condition.....	11.90	" "
" " covered with mud.....	14.30	" "
" " ruts and mud.....	26.00	" "
Earth, dry and hard.....	18.00	" "
" " ruts and mud.....	39.00	" "
Gravel, loose.....	51.60	" "
" " compacted.....	12.80	" "
Plank, good condition.....	8.80	" "
Sand, wet.....	32.60	" "
" " dry.....	64.00	" "

The comparative cost of transportation over rough roads may be estimated from Table No. 2, which shows with sufficient exactness for most practical purposes, the force required to draw loaded wagons over inclines. This table shows the force exerted by the load in its downward tendency, as well as the force required to draw it up grades of various inclinations; also maximum duty performed by an average horse, weighing, say twelve

hundred pounds, the friction of the surface being taken at one-fiftieth of the load drawn :

TABLE II.

Rate of Grade. Ft. per 100 ft.	Pressure on the plane in lbs. per ton.	Tendency down the plane in lbs. per ton.	Power in lbs. required to haul one ton up the plane.	Equiv. Length of level road in miles.	Max. Load in lbs. which a horse can haul.
0.0	2240	.00	45.00	1.000	6270
0.25	2240	5.60	50.60	1.121	5376
0.50	2240	11.20	56.20	1.242	4973
0.75	2240	16.80	61.80	1.373	4490
1.	2240	22.40	67.40	1.500	4145
1.25	2240	28.00	73.00	1.622	3830
1.50	2240	33.60	78.60	1.746	3584
1.75	2240	39.20	84.20	1.871	3290
2.	2240	45.00	90.00	2.000	3114
2.25	2240	50.40	95.40	2.120	2935
2.50	2240	56.00	101.00	2.244	2725
2.75	2240	61.33	106.33	2.363	2620
3	2239	67.20	112.20	2.484	2486
4	2238	89.20	134.20	2.982	2083
5	2237	112.00	157.00	3.444	1800
6	2233	134.40	179.40	3.986	1568
7	2232	156.80	201.80	4.844	1367
8	2232	179.20	224.20	4.982	1235
9	2231	201.60	246.60	5.480	1125
10	2229	224.00	269.00	5.977	1030

From the foregoing tables, and from statistics gathered by both state and national bureaus, it has been calculated that the average cost of transportation by animal power is twenty-five cents per ton per mile. Furthermore, the rate of transportation by animal power is, and always has been, excessively high, and the evidence of all statistics, both ancient and modern, shows but slight

wheat, beef, pork, molasses, wagons, horseshoes, butter and clothing. Within the writer's memory, these articles were produced at home, or in small shops and factories distributed, like the population, quite equally throughout the country at cross-roads and villages, utilizing crude methods and operated by the old-fashioned treadmill or horse power, and overshot water wheels. The output of flour per man per day in those mills did not exceed ten barrels. At the great Winnipeg and Keewatin mills and at Minneapolis the milling business has been so concentrated that to-day the output per man exceeds one hundred barrels and the cost of production is correspondingly reduced. But of what benefit to inaccessible property in the interior is this reduced cost of production, unless like facilities for transportation are afforded?

The measure of benefit which any improvement in production in one community bears to another community, depends entirely upon the transportation facilities between the two places. Recently a customer came into our office from one of the interior mining districts. We estimated the plant he required would cost \$1,255. To help him out all we could, we eliminated every possible item not absolutely essential to the proper working of the plant, and allowing also for erector not being required, we found we could reduce our price 10%, making the net total \$1,130. But how insignificant our discount appeared when we learned the freight from Montreal to the mine would cost \$1,248, notwithstanding no part of the route required mule-back transportation. Although further distant from Montreal, the same plant could be transported to Vancouver for less than \$250.

Concentration of population and production requires for the better equalization of supply, and price of materials and provisions, that such centres must be provided with commercial veins and arteries which shall quickly and cheaply transport or exchange urban and suburban passengers and commodities. While long haul rates of transportation by railroads and steamships have been

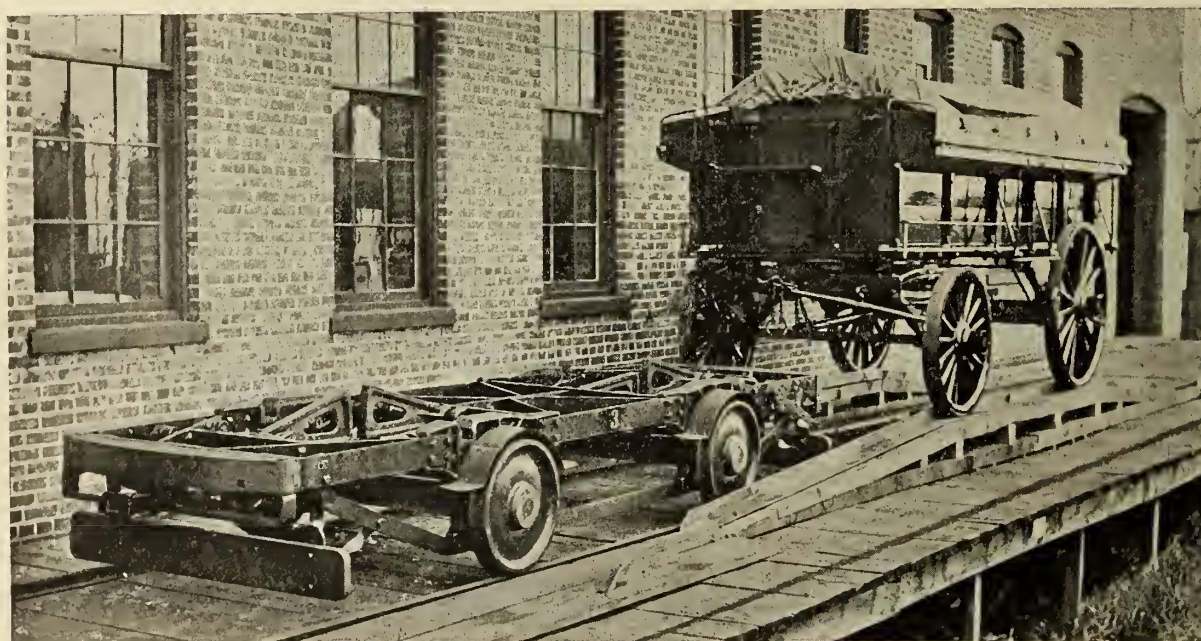


FIG. 1.

improvement as compared with the progress made in other departments of industry, and by other means of transportation. It being true that the value of land and wages of labor are affected by the cost of transportation, we should expect to find that where so high a rate as twenty-five cents per ton-mile prevails, the land would diminish in value, and the rewards of labor bestowed upon such lands would grow less and less. What we expect to find, we do find.

A forcible illustration of this fact was brought to the writer's attention a few days ago. A resident of Long Island, living about fifty miles out from New York city, owns 500 acres of as fertile land as may be found anywhere. Although beautifully situated, and with every natural advantage to favor production, the cultivation of all staple products has been abandoned by him owing to lack of proper transportation facilities. With potatoes jobbing at eighty cents to one dollar per bushel in New York, he was compelled to sacrifice his entire crop, giving away hundreds of bushels, rather than allow them to rot in his cellars.

It is not necessary for the careful observer to rely solely upon official reports for information, for the above is but an every-day example of the result of excessive cost of transportation, the ever-decreasing price of inaccessible land, and the diminished rewards of labor bestowed upon it. The price of land and the value of labor decreases in almost inverse proportion to the distance over which the agricultural products must be transported by horse power.

One fact is patent to all, that whereas formerly the distribution of population was approximately equal over the face of the country, it is gradually becoming concentrated into large cities to such an extent that already fully one-half of the inhabitants of the older sections of the country live in cities. The evident reason for this is competition, the demand for increased output at reduced cost. Concentration indicates increased power for production. Take, for instance, some of our commonest staples, like

wonderfully cheapened, there still remains a space of fifteen to twenty-five or even forty or fifty miles surrounding every commercial centre, which has never been covered by any cheap method of transportation. Such distances are beyond the possibility of cheap or efficient service by animal power, and the terminal charges and bulky plant required, precludes any possibility of much reduction in railroad tariffs. What we require therefore is a new system of transportation which shall be alike available for freight and passengers.

The problem of handling exclusively passenger traffic is comparatively simple; indeed it has already been solved for those districts where the population is sufficiently dense to support steam or electric railways requiring no other source of revenue. Experienced railroad men are unanimous, however, in agreeing that no road, whether steam or electric, will pay in a thinly settled district, unless assisted by a bonus or by the addition of freight traffic.

In this day of great competition capital is constantly seeking methods for reducing costs. Manufacturers calculate even the individual bristles required to make a brush, and the ounces of warp in a yard of cloth. An extra hair in a brush or an ounce of warp more than is necessary, does not amount to much in a single brush or a yard of cloth, but the savings in a day's output might make a perceptible increase in the dividend account. Cost of operation and maintenance are to-day the great factors in every commercial or manufacturing calculation. Capital is ever ready to supply the installation provided it can be insured a fair return on the investment.

This age has not only developed the mechanical and the electrical engineer, but to-day they are striving harder than ever to distance as far as possible the civil engineer whose development of the highway, the canal and the railroad, made him famous years ago. That the civil engineer has achieved wonderful results in the operation of steam roads no one will deny, but for the

solution of the short haul problem we must eliminate his cumbersome trains, his extensive terminals and expensive equipment and service generally, before we can hope to approach the mean line of tariffs which shall re-establish the movement of commodities within every part of the short-haul circle. Then may we expect a more even balance of land values, and from the increased traffic

mediate benefit of the higher city market rates for their produce, as well as competitive selection and prices for supplies. Local and sub-stations were to be established at frequent points along the line where the farmers could deposit their produce to be forwarded by next train to a central clearing house in the city from whence it could be delivered at once to the consumer. The

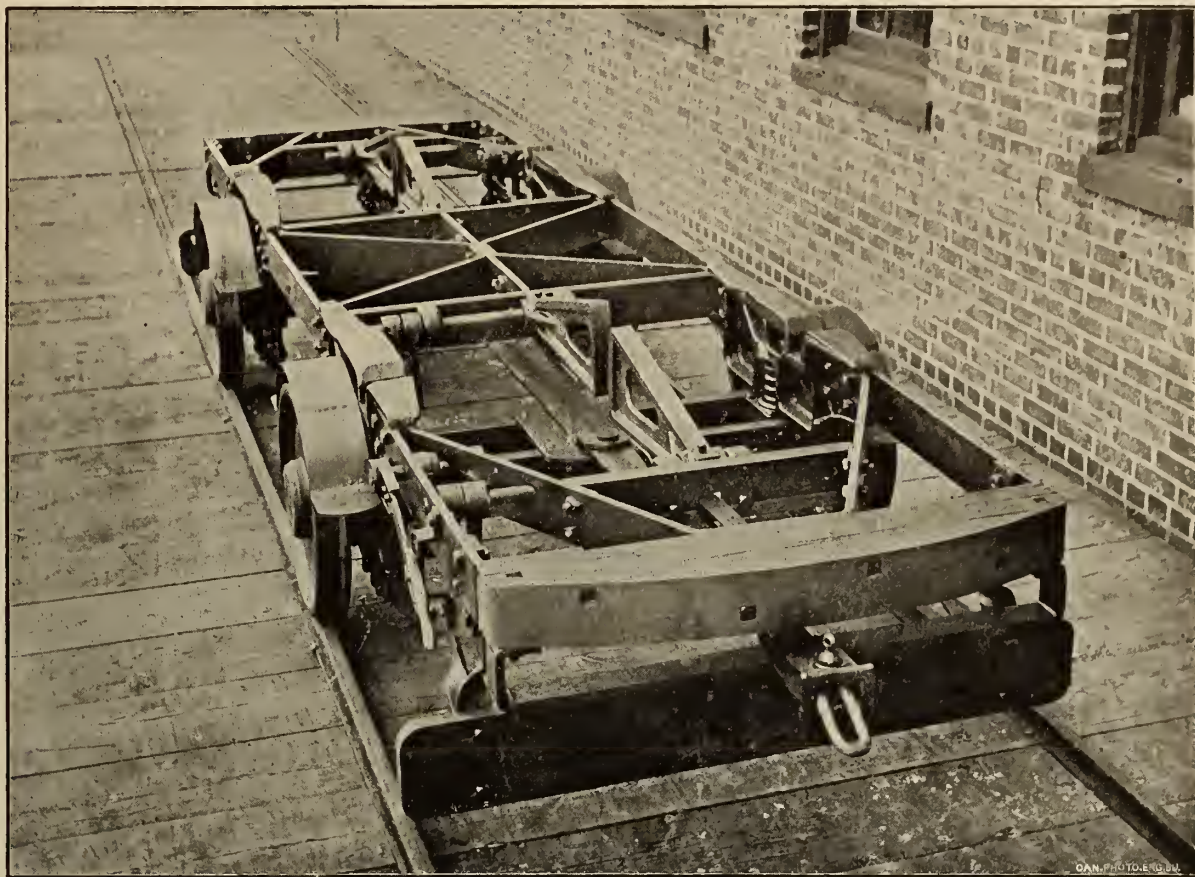


FIG. 2.



FIG. 3.

will come substantial dividends to the investor in railway securities.

In 1894 the writer promoted a scheme for uniting one of the large commercial centres on Lake Erie with several surrounding counties by a system of electric railways which would combine both freight and passenger traffic. The arrangement was such that the farmers anywhere along the line would secure the im-

scheme was to be co-operative in a measure, the subscribers to receive the first benefits. Telephone connection was to be established between the city and farm residences through the company's local stations, and direct orders for goods from the city merchant could be received by wire and despatched by next train out. Only samples, or a very limited supply of staple goods,

were to be kept at the local stations, the principal stock to be maintained at the central clearing house, and by the various city merchants who belonged to the syndicate. Electric current for light and power were also to be supplied to consumers along the line. In short it was proposed to so unite city and country by wire and rail that all would enjoy equal facilities for obtaining supplies.

Unfortunately the financial depression of that year so handicapped our efforts that we were unable to carry out the project, but those who gave the subject most careful consideration at the time still expect to see some such system as the above in general use.

The latest development in the line of providing for goods traffic on electric tramways came to the writer's notice some months ago in the shape of a combination vehicle, so constructed as to be readily convertible for use upon any ordinary roadway or upon a railroad track. It can be shifted from one to the other at will, without the necessity of reloading or rehandling the contents between points of shipment and destination. The idea is not altogether new, but the application will no doubt impress you all as novel in the extreme.

Notwithstanding the similarity of names the writer begs to disclaim any connection with the introduction of this scheme, but

The rail truck is not materially different from the car truck in general use upon our electric railways, except that it is provided with special attachments for automatically gripping and supporting the wagon proper. The truck is exceedingly simple in design and very light in proportion to its strength, being constructed entirely of wrought iron and cast steel.

Figure 2 shows more clearly the detail construction of the rail truck and the arrangement of the cast steel segments or dogs, supported in place horizontally by heavy plate springs, and used for the purpose of engaging the axles of the road wagon as the truck approaches from either direction.

Figure 3 shows the road wagon in position on the loading switch with rail truck underneath, the dogs engaging the axles, ready to pull ahead. As the truck is drawn forward on the level rail by the electric motor, the impact of the projecting dogs against the wagon axles also starts the wagon forward, and as the latter travels down the inclined switch track, the axles gradually settle into the notch provided in the cast iron journal frames.

Figure 4 represents the wagon mounted on rail truck standing on the open track ready to be coupled to a motor car, or electric locomotive.

Figure 5 illustrates a train of five wagons, drawn by a familiar

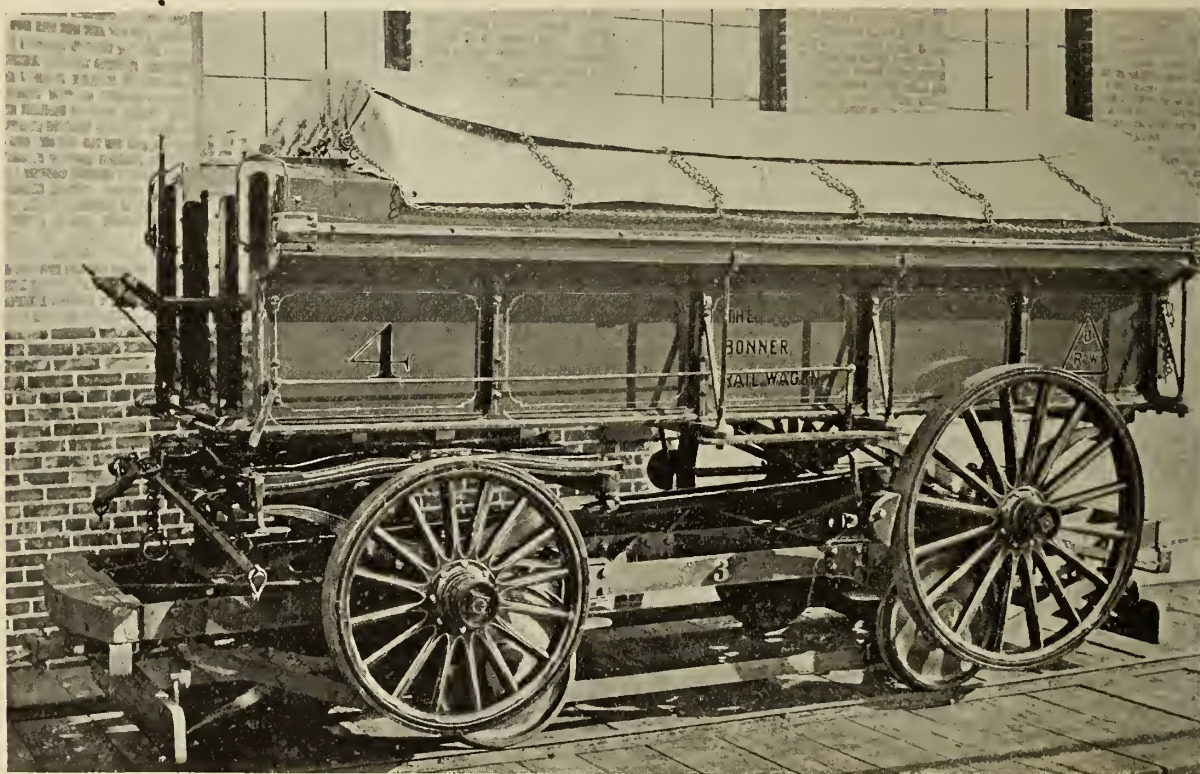


FIG. 4.

nevertheless the principle involved certainly commands attention.

The Bonner Rail Wagon Company, organized about a year ago to develop the patents of Col. Jos. C. Bonner, of Toledo, Ohio, states in its prospectus that it will build rail wagons and operate them through leases or franchises granted to interurban electric railroads. It is proposed that such roads shall be equipped with any stipulated number of rail wagons, thus enabling them to supply patrons at any point along their lines, or at the terminal stations.

The general supervision and control will be vested in the Rail Wagon Company, thus relieving the local electric railways of the detail inspection and repairing, as well as freight contracting. The Wagon Company will contract to provide service as the traffic of the electric roads may require. The wagons will be neat and substantial and tarpaulin-covered at all times, whether loaded or not, after the same manner as the goods vans are covered on English and continental railroads. This provision permits sealing and also provides protection against exposure to inclement weather.

As an essential feature of this enterprise, the Rail Wagon Company will supply horses and drivers for service at terminals, thereby retaining in responsible hands, the execution of traffic agreements and establishing a direct-connecting link between the producer and the consumer. Agents will collect the freight charges, which charges will include delivery to consumer. The tariff rates, covering both freight and delivery, will naturally be much less than prevailing freight charges under old methods of transportation, since no allowance need be made for capital invested in expensive terminals or for maintenance of same.

Figure 1 of the annexed cuts illustrates the integral parts of the combination vehicle. The wagon proper is patterned after the ordinary improved road wagon, modified, of course, for the special nature of the service contemplated. The running gears and springs are of standard construction having a carrying capacity of from three to seven tons, depending upon the class of freight to be carried.

looking electric locomotive en route across the country, while figure 6 represents several rail wagons side tracked in convenient market stalls, the commission agent or owner serving out the contents fresh from the farm.

The actual time required for unshipping the wagon from the truck for road use, and vice versa, is not more than would be required for coupling together cars in making up a train.

The weight of the combined wagon and truck is sufficient to insure perfect rail traction and the proportion between carrying capacity and dead weight averages about the same as the ordinary freight car.

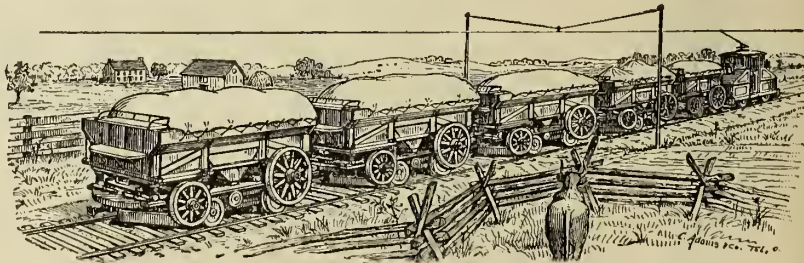


FIG. 5.

By establishing a uniformity of dimensions and making the rail truck interchangeable, the wagons can be loaded either end on from either direction, and any number of rail wagons can be connected and moved in either direction as a train, by steam, electric or other motive power.

The farmer or merchant need have no ownership in the rail wagons. On a signal or other notice to the electric railroad, a rail wagon may be placed on a convenient farm switch or siding. The farmer readily unships the wagon from its rail truck by simply hitching his horses to the wagon and driving off, leaving the rail truck to remain where it stands until he returns with wagon loaded for market. Convenient receiving and distributing stations can be located in the cities. Bulk merchandise can be

handled; parcels, mail and express matter also, the rail wagon making store to store collections or deliveries. The movement of these rail wagons need not in any way interfere with passenger service of the electric railways, the heavy traffic being carried at night, when the electric lines and streets are least in use.

The great value of this novel method of handling goods traffic is readily demonstrated. Not only does it insure economy of time, labor and expense by avoiding reloading in transit, but the reduction in breakage which usually attends the shipment of eggs, glassware, pressed brick, or other fragile commodities, guarantees for it preference over other systems of transportation.

With these changed conditions of suburban traffic the greater part of the haul would be by rail, consequently the weight of the load units can be greatly increased. A team of horses can exert, for a short period, twice the average tractive pull which they would be able to exert continuously throughout a day's work, and, so long as the resistance on the incline is not more than double

tractive power, since any appliance which offers increased permanent demand for current must add a corresponding value to his franchise.

As will be noticed by an inspection of the accompanying illustrations, the Quimby pump consists of two parallel shafts, on which are mounted the four screws that act as pistons in propelling the water, so arranged that in each pair the thread of one screw projects to the bottom of the space between the threads of the opposite screws. The screw threads have flat faces and peculiarly undercut sides; the width of the face and the base of the thread being one-half the pitch. The pump cylinder fits the perimeters of the threads, as shown in figure 2.

Space enough is left between the screws and the cylinder and between the faces of the intermeshing threads to allow a close running fit without actual contact. There is no end thrust of the screws in their bearings, because the back pressure of the column of liquid is delivered to the middle of the cylinder, and the endwise pressure upon the screws in one direction is exactly counterbalanced by a like pressure in the opposite direction.

The suction connection is shown at S in Fig. 1, and opens into a chamber underneath the pump cylinder. The suction liquid passes through this chamber to the two ends of the cylinder, and is forced from the two ends toward the centre by the action of the two pairs of intermeshing threads, the discharge being in the middle of the top of the cylinder, as shown at D.

The power to drive the pump is applied to one of the shafts, and the second shaft is driven by means of a pair of gears, shown at G in Fig. 1.

The pump has no internal packing, no valves, and no small moving parts. The only packing is in the stuffing boxes where the two shafts pass through the cylinder head. As these stuffing boxes are on the suction end of the pump, there is no tendency to blow out the packing.

The Quimby electric pump is especially valuable in connection with the hydro-electric operation of elevators. These pumps have been in use for elevator service for several years with very satisfactory results, and have been successfully applied to the pressure tank system, the gravity system, and for pumping directly into the elevator cylinder.

When used in connection with the pressure tank system, the suction is connected with the elevator discharge tank, the pump discharging into the pressure tank. The pump is controlled by means of a pressure regulator and starting box, as illustrated in Fig. 3. When the pressure in the tank falls, the regulator operates the starting box and the pump runs until the pressure has been restored in the tank to the required number of pounds.

By the peculiar construction of the Quimby pumps there is no pulsation, and the flow of water is smooth and continuous, thus enabling the pumps to pump air into the pressure tank easily and without danger of air binding.

When used in connection with the gravity system, the pump section is connected with the lower discharge

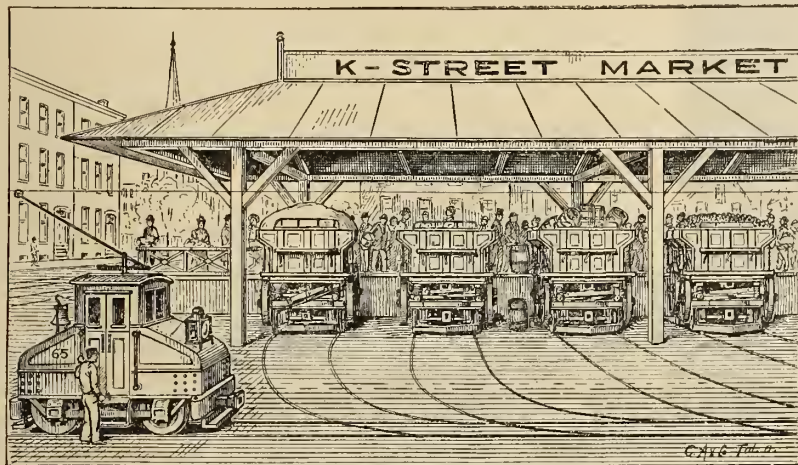


FIG. 6.

the resistance on the level, it follows they would be able to draw over short hills the maximum load they are capable of drawing along a level road.

Such a system as the above would at once render accessible endless acres of fertile interior lands, and open them up to the systematic energy of the thrifty market gardener, the dairyman and the fruit grower. Improved conditions would result to the truck farmer, who would no longer be obliged to spend his night in long weary drives in order to reach the early market. Instead, his day's harvest would be transported to town during the night by electric rail wagon while man and horse refresh themselves in sleep.

Thus would we increase the market value of distant agricultural lands, and at the same time retain present values of nearby property. With the increase of land values and production, must also come increased traffic for existing or proposed suburban railways.

THE QUIMBY SCREW PUMP.

By W. T. BONNER, Montreal.

THE probable increased demand for electric current due to the introduction of this new type of pump, which has entered the field of competition for commercial success within a recent period, should offer sufficient reason for describing it briefly in a paper for the benefit of this Association. The novel feature of the pump is its sim-

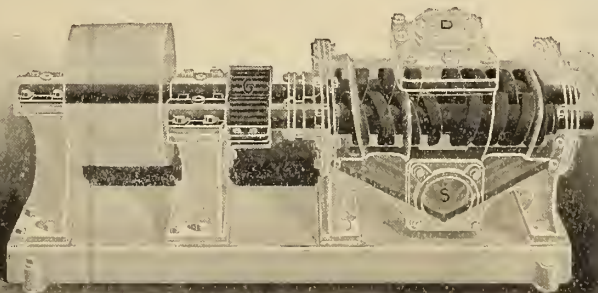


FIG. 1.



FIG. 2.

plicity, utilizing as it does a very simple mechanical principle in a very unusual manner for performing useful work.

Without attempting to refer to the many more or less successful efforts of other inventors, contemporary with or prior to Mr. Quimby, this paper will be confined to a brief description of the pump, with some further reference to its commercial success. The latter is, of course, a first consideration to the manager, or owner of elec-

tank, and the discharge from the pump is elevated into the roof tank. The pump is controlled by means of a float in the discharge tank, and a starting box. When the discharge tank is full the float rises and starts the pump; the pump then runs until the discharge tank is empty and the roof tank is full. When the discharge tank has been emptied the float stops the pump. This system of control is simple and works exceedingly well in practice.

For pumping directly into the elevator cylinders, these pumps have a very high efficiency. The multiplication of cylinders in a reciprocating pump diminishes the in-

be automatically operated, thus doing away with the constant care and attention required by a steam pump.

Figure 5 represents a switch for automatically starting and stopping electric motors up to and including five horse power. It is arranged to allow the current to gradually enter the motor through resistance, preventing undue sparking at the commutator at the time of starting the motor, thus taking the place of a starting box or rheostat, which is usually operated by hand. For pumps of larger size it is advisable to use the controlling apparatus shown in Fig. 3.

Whether operated by belt or direct connected to

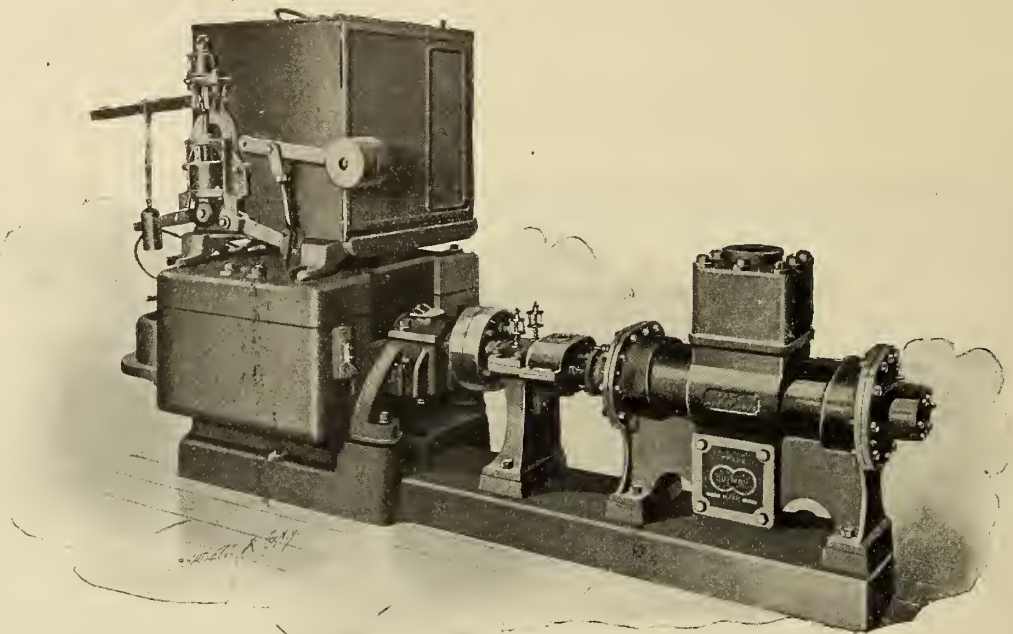


FIG. 3.

tensity of the effect of the pulsations by increasing their frequency, but does not entirely remove the pulsations. Where Quimby pumps have been applied to pumping directly into the elevator cylinders, the motion of the cars is as smooth as in the pressure tank system. The advantage of direct pumping is that the pressure against which the pump works is proportional to the load in the car, and as the average elevator load is about half the maximum load, the saving in comparison with the pres-

electric motors or steam engines, the Quimby pump has many advantages. For waterworks, oil refineries, or other service where liquids are pumped through long pipe lines, any pulsation in the delivery adds to the difficulty of maintaining tight joints. The Quimby pump, however, has an absolutely pulseless delivery, and at the same time a very high efficiency. Long series of tests show an average efficiency of more than 55 per cent. from wire to water. In many instances tests have shown as high as 65 or 66 per cent. efficiency. The log of two tests is given below in order to show the variation in output of current per gallon of water pumped under different heads.

TEST NO. 1

No. 2½ Quimby pump direct connected to 1 h.p. Lundell motor.

Pressure.	Volts.	Amperes.	Revolutions.	Lbs.	Time.
2	226	1.25	1860	292	1 min.
10	230	1.75	1650	244	"
20	230	2.00	1520	208	"
30	220	2.50	1280	178	"
40	226	3.00	1255	160	"
50	222	3.25	1130	133	"
60	228	3.75	1130	122	"
70	234	4.5	1020	102	"
80	224	4.5	990	81	"
90	222	5.0	955	76	"
100	234	5.5	950	75	"

TEST NO. 2.

No. 5 Quimby pump direct connected to No. 4 Otis motor.

Pressure.	Volts.	Amperes.	Revolutions.	Gallons.	Efficiency.
30	210	35	1280	316	56
40	"	43	1260	300	57
50	"	49	1220	286	60
60	"	57	1180	273	59½
70	"	62	1160	250	58½
80	"	68	1100	231	56
90	"	75	1080	222	55

The peculiar construction of the Quimby pump is such that it will readily handle thick products, such as paraffine, hot tar, pitch, white lead, melted sugar, glucose, soap, lard, etc. For this service, reciprocating pumps are not desirable, for the reason that heavy liquids are likely to be churned by the action of the plungers, and the friction of the material passing through the valves and ports, greatly reduces the capacity and efficiency.

The Quimby pump has now been in actual use suffi-

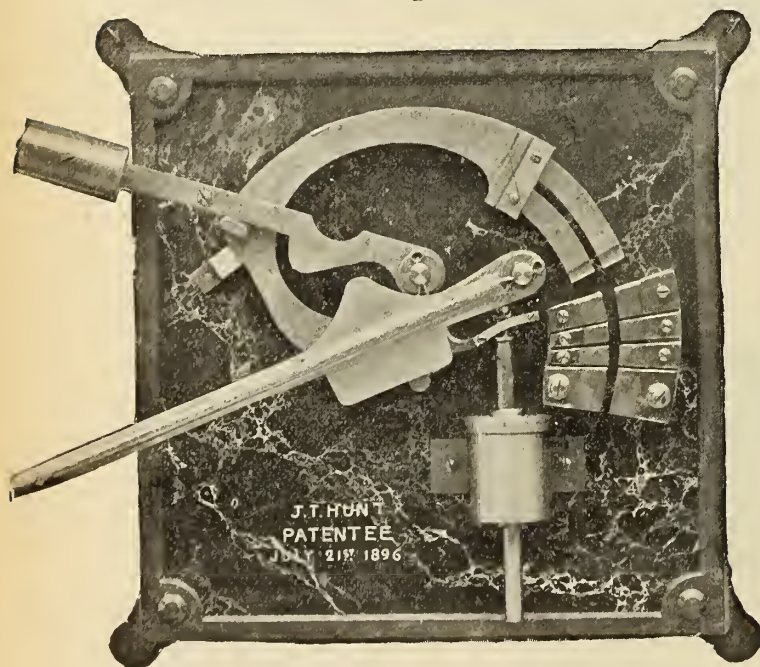


FIG. 5.

sure tank system is obvious. Where an elevator has been operated by water from the city mains, a considerable saving can usually be effected in the cost of operation and the service much improved by the application of an electric pump.

It will be seen from the foregoing description that the Quimby electric pump, when applied to an elevator, can

ciently long to have passed the experimental stage. It is being used for all kinds of service, under most trying conditions, and the results have proved its efficiency, durability and economy.

The writer recently inspected one of the number seven pumps installed in the New York Sun building, where it is being used in connection with elevators operating on the pressure tank system. The arrangement of the pump and motor is the same as shown in Figure 4, while the rheostat and controlling device are similar to that shown in Figure 3. The instant the pressure on the gauge tank indicated a discharge of the water, the controlling device would close the circuit and start the pump, which would continue to run until the pressure reached the normal limit, when the current would be shut off, and the pump would stop. In its operation, both pump and motor appeared to be perfectly automatic, and the absence of noise and vibration was very noticeable.

The writer was also shown other installations of

including five submarine cables of a combined length of about 16 miles.

From Quesnelle the main line crossed the Fraser river to the westward, and following a north-westerly course, with Behring Strait as its next objective point, reached the Naas river—about 400 miles distant from Quesnelle—when the second Atlantic cable was successfully laid, and operated July 29th, 1866.

The construction party of about 250 men—and which included explorers, surveyors, choppers, line builders, operators, and transport gangs—on receiving the news of the completion of the cable, remained in camp two or three days, awaiting developments. At the end of this time, finding the cable continued to work well, they set out for civilization, leaving their tools, stores and material to the tender mercies (in great part) of the Hudson's Bay trappers and the native red man, as their transport out would have cost more than the new article.

During the winter of 1866-7, a station was maintained at Fort Stager, on the Skeena river, where an operator by name of Mc- Cartney and a companion domiciled until the following spring, and where oftentimes during those—to him—dreary winter months I held converse with him by wire from Yale.

In addition to the construction party, the company owned and had in service a fleet of vessels, steam and sail, plying upon ocean and river, some in the transportation of material, supplies and line

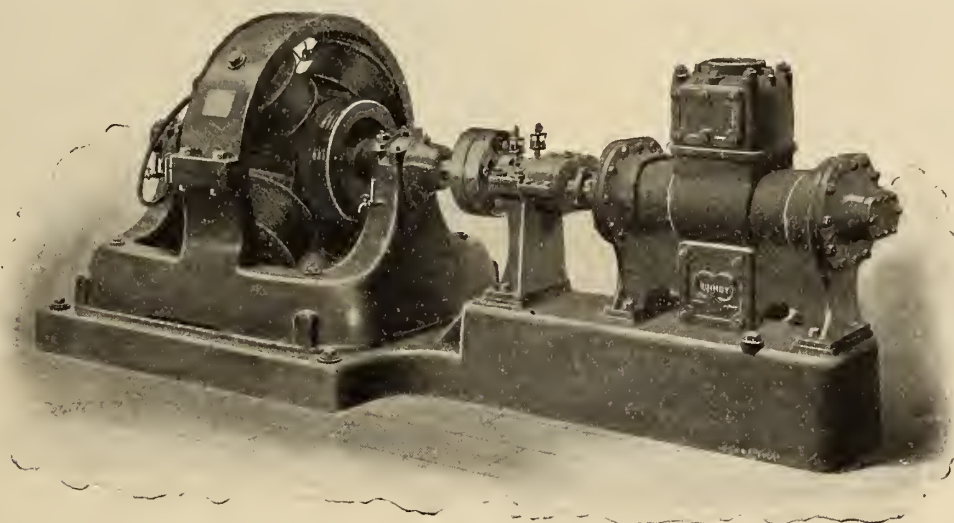


FIG. 4.

Quimby pumps for various purposes, such as tank service for high commercial buildings, elevating melted sugar from the basement to the top floors in refineries, and for other service.

Altogether the Quimby pump appears to offer a wider range for the utilization of electric power than any other apparatus presented for some time past and in a field also where cost of installation and operation are both very important factors.

THE TELEGRAPH IN BRITISH COLUMBIA.

By R. B. McMICKING.

SINCE that excellent paper on the "Early Construction of Telegraph Lines in the Dominion" was submitted at the fifth convention by Mr. Charles P. Dwight, I have had in mind the need of a supplementary clause concerning the introduction of the telegraph into this province in the early sixties, and which was to constitute a section of the somewhat formidable undertaking of connecting the New with the Old World by means of about eighteen thousand miles of land line.

It may be—it doubtless is—within the recollection of some of our members that, on the failure of the first Atlantic cable in 1858, there was set in motion as a means of attaining the same end—i.e., telegraphic communication between the two hemispheres—a gigantic enterprise, known as the "Collins Overland Telegraph (Russian Extension) Company," having in view the stretching of a wire from the telegraphic system of the Pacific States, through British Columbia, and via Behring Strait to Russia and Europe.

With marvellous energy and enterprise, the work of construction was commenced in 1863, the line entering British Columbia from the south in Longitude 122 W. in 1864, being carried thence to New Westminster, from which point it followed the valley of the Fraser river and the Cariboo wagon road northward to Quesnelle, a distance of about 450 miles, which point was reached in 1865. Offices were established along the way, and from Quesnelle southward the line was soon opened for commercial business. The enterprise proved a great boon to the early colonists, both by reason of the large expenditure necessary in its construction and operation, as well as by the facilities offered thereby to the widely separated settlements for speedy communication.

In 1865, also, a branch line was run across the San Juan Archipelago to Vancouver Island, connecting Victoria, the capital of British Columbia, with the main line at Swinomish, Washington Territory. This branch was about 74 miles in length,

equipment, others in preparing for the placing of a cable across Behring Strait, a distance of about 60 miles—quite an undertaking at that date.

Of the fleet, I now recall the ocean steamer "George S. Wright," the river steamer "Mumford," barques "Onward," "Clara Bell," "H. L. Rudgers," ship "Nightingale," schooner "Milton G. Badger." The "Onward" made a trip to Siberia with material and supplies, was caught in the ice—where she remained all winter—and became a wreck when the ice moved in the spring.

The Behring Strait cable was to stretch from Cape Prince of Wales, on this side, to Plover Bay, on the Siberian shore, from which latter point inland about 350 miles of line had been erected, while southward from Cape Prince of Wales, in Russian America, about 300 miles of land line had also been constructed.

The course of this contemplated line through the British possessions and down the great waterways of Russian America would doubtless have brought it into close proximity to the present Klondyke gold fields, and near Dawson City, in which event it is not improbable that the hole-digging necessary would have developed the riches of that section at least 30 years earlier, and have given to the former generation an additional important mining epoch.

The history of the building of this line, and the causes which led to a work having for its object the encircling of the world by wire at so early a date, is likely always to be read with interest.

The company—which subsequently merged into the Western Union Telegraph Company—maintained the line northward as far as Quesnelle until purchased in 1870 by the British Columbia government, which in turn handed it over to the Dominion government on British Columbia entering the Confederation in 1871. Later still, the Canadian Pacific Railway assumed control south from Ashcroft. While under government control, and previous to the influx of population consequent upon the building of the Canadian Pacific Railway, the revenue fell far short of the expenditure yearly.

In 1867, Buie Bros., merchants, built a branch line from Quesnelle to Barkerville, in the Cariboo gold region, a distance of 60 miles. This branch, together with the main line between Quesnelle and Ashcroft, is still operated by the Federal government.

The original expenditure in the construction of the British Columbia section of the Intercontinental line reached the large sum, roundly, of three million dollars.

I have written from memory, yet, doubtless, with comparative accuracy, through having been in the company's service during construction and for some years afterward, and while in charge of Quesnelle office in 1866 becoming the medium by which the news of the successful laying of the Atlantic cable, July 29th, 1866, reached the construction party 400 miles north-west of that point on July 30th, 1866.

THE STEAM END.

By JAMES MILNE.

In a paper read at a former convention of this Association, it was stated that purchasers of electrical apparatus made very careful enquiries as to the efficiency of same, the price being of secondary importance. If this applies to the electrical, why should it not apply to the steam end as well? I am sure that there are very few plants where the proprietors, or those in charge, inquire as to the efficiency of the boilers and engines, the price with these items being the very first consideration, generally.

It is very seldom, in specifications for steam plants, that there is anything said about the efficiency of the boilers, or the water consumption per horse power hour at the engine. This I consider one of the most important points in connection with the steam plant. There are engines running which are supposed to be first-class and up to date, where the water consumption per horse power hour is nearly double what it ought to be, and if the management in some of these plants would go to the trouble of calculating the coal consumption per electrical horse power at the bus, I am of the opinion that the results obtained would simply astonish them. I, myself, have records of the coal consumption of a plant, together with the total meter readings, extending over a number of years, and allowing for the loss on the line, together with that on the generators, and although the plant was a non-condensing one, yet the records there are not out of the way. In another plant where I was making a two days' test as to the relative values of coal, I found the coal consumption per E.H.P. at the bus just double the former plant, which might be considered high by some. This second plant was condensing. The load was of such a nature as to make the engine very unsuitable for the work.

I am inclined to think that builders of engines should be made to guarantee a certain steam consumption per indicated h.p. at say 25% over-load, full load and half load, and that tests should be made to determine if the guarantee has been fulfilled. If the guarantee has been more than fulfilled, let a bonus be given to the builders, and if not fulfilled, so much to be deducted for every 1% below the guarantee; and if it falls below a certain amount, that is to say, the steam consumption exceeds a certain fixed value, the engine to be removed, or the builders to accept a nominal figure for same. I think if means of this kind were adopted we would get engines of a very high order. Engineers, as a rule, are content so long as they get a fine looking card from their engine, but they very seldom from these cards calculate the steam consumption, which is of vital interest.

We have quite a large number of good engine builders in the country, but the number guaranteeing their efficiency is very limited indeed; in fact, I am not aware of any. If tenders are invited for a certain style of engine and the tenderers are called upon to guarantee the steam consumption per B.H.P., the party to receive the contract is the one guaranteeing the least steam consumption per h.p. hour, the cost being of secondary importance. After the engine has been installed and run for some time so as to get down to its proper bearing, carefully conducted tests should be made to ascertain if the guarantee has been fulfilled.

The matter of efficiency of boilers is also one of great importance, but it is not so easily arrived at, owing to the difference in coal. At the same time however, it would not be a very difficult matter to fix on a certain coal for a standard, and to guarantee so many pounds of water evaporated per lb. of that coal. All boilers, I believe, should be sold by the Centennial Standard, and should be capable of developing their rating with easy firing, showing good work with ordinary coal, and should be capable of being forced 50 per cent. above their rating. There was a recommendation something to this effect made by the Committee of Judges at the Centennial Exhibition, the horse power being $34\frac{1}{2}$ lbs. from and at 212° , which is equivalent to 33,305 heat units. We should get an efficiency close on to 80% with good boilers, and this could be roughly determined with anthracite coal, and if we get 12 lbs. of water evaporated from and at 212° , we have approximately this efficiency, the heating value of the combustible being about 14,500 heat units, which is equivalent to 15 lbs. evaporated from and at 212° , therefore 80% of this gives us 12 lbs. With bituminous coals we have not such uniformity, and it is necessary to determine its heating value either by the coal calorimeter or chemical analysis.

After our boilers and engines are installed, we have to face the problem of running them. It has often been stated that men could be got to do anything, men being more easily replaced than machinery, costing practically nothing as it were. I am of the opinion that this is wrong. Cheap men are numerous we know, but are in the long run very expensive. Good men are scarce, and nowhere is this more noticeable than in the boiler room. Good firemen are very scarce, coal shovellers numerous. In my humble estimation, credit is not given to the fireman that should be. If a plant is run fairly economical as far as coal consumption is concerned, the engineer is more apt to get this credit, but as a matter of fact all he does is to turn on the steam and see that the bearings are oiled. Now and again he may walk into the boiler room to ascertain if the fireman is asleep or not.

To have good firing the greatest of skill has to be manifested to get the best results from the coal, and where we are dependent on skill to get first-class results we are depending on a very uncertain quantity. Too much latitude is given the fireman in the matter of coal, and he has it in his power to make or lose nearly a dividend for the company that employs him. Attention is being given to this subject by the largest steam users in the country, whereby the duties of the fireman are being greatly relieved by mechanical devices; their action being positive and not dependent on skill, the machines thus taking the place of the brains of

the fireman. This you will agree is a great step in advance, and makes central station management very independent regarding firemen.

SPARKS.

The Kingston Locomotive & Engine Company have re-elected the old board of directors.

The Whitney Electric Company's works at Sherbrooke, Que., were damaged by fire last month to the extent of \$1,000.

After using acetylene gas in the Methodist church at Leamington, Ont., it has been decided to return to electric light.

At the annual meeting of the St. Martins, N.B., Telephone Co., the former board of directors and officers were re-elected.

A. Schneider & Co., Pearl street, Toronto, manufacturers of electrical machinery, etc., have removed to 106 York street.

Mr. T. A. Crandall, of Picton, Ont., in remitting subscription to the ELECTRICAL NEWS, writes: "I don't think I could get along without your paper."

It is stated that Gordon & Phillips, of Chatham, Ont., will establish a woollen factory at Tweed, Ont., and put in an electric light plant.

The steamer "Lakeside," plying between Toronto and St. Catharines, is shortly to be fitted with a complete new system of electric bells.

The village of Acton, Ont., will probably install a municipal lighting plant. An electrical engineer may be engaged to report on the matter.

The Deschenes Electric Company have submitted a proposition to the council of Ottawa East to supply light and power. The question will be considered at next meeting.

The electric street railway at St. Thomas, Ont., was put in operation last month. The railway cost about \$80,000 and is six miles in length, and the entire equipment is very complete.

The George White & Sons Co., engine and machinery manufacturers, of London, Ont., have recently completed a new building, 175×35 feet, in which to manufacture threshing machines.

The village council of Iroquois, Ont., has under consideration a proposal from Mr. Keefe for an electric lighting franchise. Should an agreement be reached, Mr. Keefe will put in the necessary plant.

The employees of the Ottawa Electric Railway recently asked for shorter working days, but were informed by the company that this could only be granted upon a corresponding reduction in wages.

At the session of the Provincial Legislature of British Columbia recently adjourned, incorporation was granted to the Mountain Tramway & Electric Co. and the Nanaimo Electric Light, Power & Heating Co.

An exchange recommends the use of oak bark as a preventive of corrosion in steam boilers. Tests have been made which are said to have proven satisfactory, one or two oak slabs only being put into the boilers.

The Strathroy Electric Co., Limited, have met with so much success that they recently placed an order with the Canadian General Electric Co. for the installation of another 500 light single phase alternator.

The Ashcroft Water, Light and Power Company will erect a power house on the Bonaparte river, about three miles from Ashcroft, B.C., and install an electric plant to furnish light and power to Ashcroft, and for irrigating purposes.

J. R. Goodchild's electric light plant at Amherstburg, Ont., was put in operation last month. The generator is a 600 light Westinghouse of the latest design, the engine 75 h.p., and the boiler 150 h.p. Mr. McLean is electrician.

Mr. O. E. Young, of Magog, is building a small pleasure boat for Mr. L. B. Ward, of Brooklyn, N. Y., to be used on Lake Memphremagog, and an order has been placed with the Jenckes Machine Co., of Sherbrooke, Que., for one of their 7 h.p. Dake marine engines, with boiler to run the same.

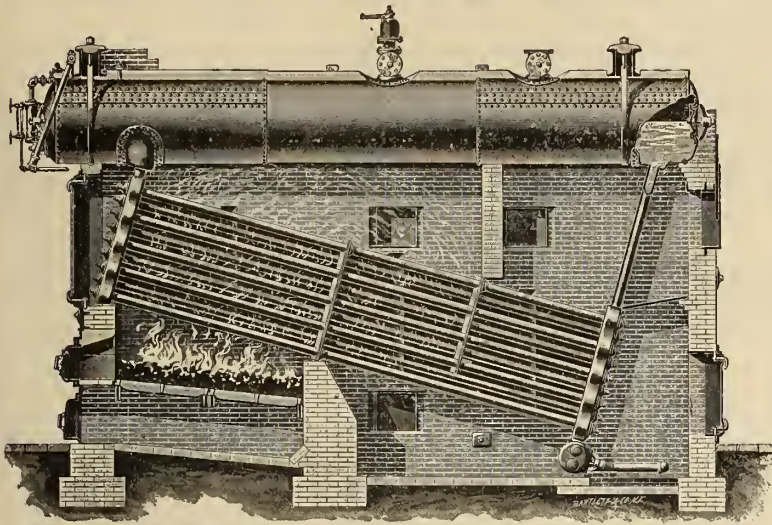
The project to produce water power by the construction of a diannel from the Welland to the Jordan rivers has again been revived. Mr. Wm. Pearson, C.E., of Oswego, is said to have pronounced the scheme feasible from an engineering standpoint, and the question of disposing of the power will now be tested. Mr. Pew is the promoter.

The Ottawa Electric Co. have supplied their employees whose duty it is to read meters with a portable electric light worked on the storage battery system. The light is five candle power and will run continuously for twelve hours without change of battery. The article complete weighs only 8 ounces, and the battery may be readily carried in the coat pocket.

The corporation of the town of Granby, P.Q., recently gave the contract for the installation of their lighting plant to the Canadian General Electric Co. This plant will consist of a 100 k.w. monocyclic generator, complete equipment of station instruments, and a 50 light Wood arc dynamo. The contract also includes the complete installation of the pole line, transformers and house wiring required.

The New Brunswick Telephone Company recently elected the following directors: Hon. A. G. Blair, president; F. P. Thompson, managing director; J. L. Black, vice-president; W. E. Smith, secretary-treasurer; Dr. A. A. Stockton, Chas. Fawcett, C. F. Sise, W. T. Whitehead. The directors have decided to replace the present wire on the trunk system between Fredericton and St. John and Amherst, N.S., with copper wire.

BABCOCK & WILCOX WATER TUBE STEAM BOILERS



First Invented in 1856.

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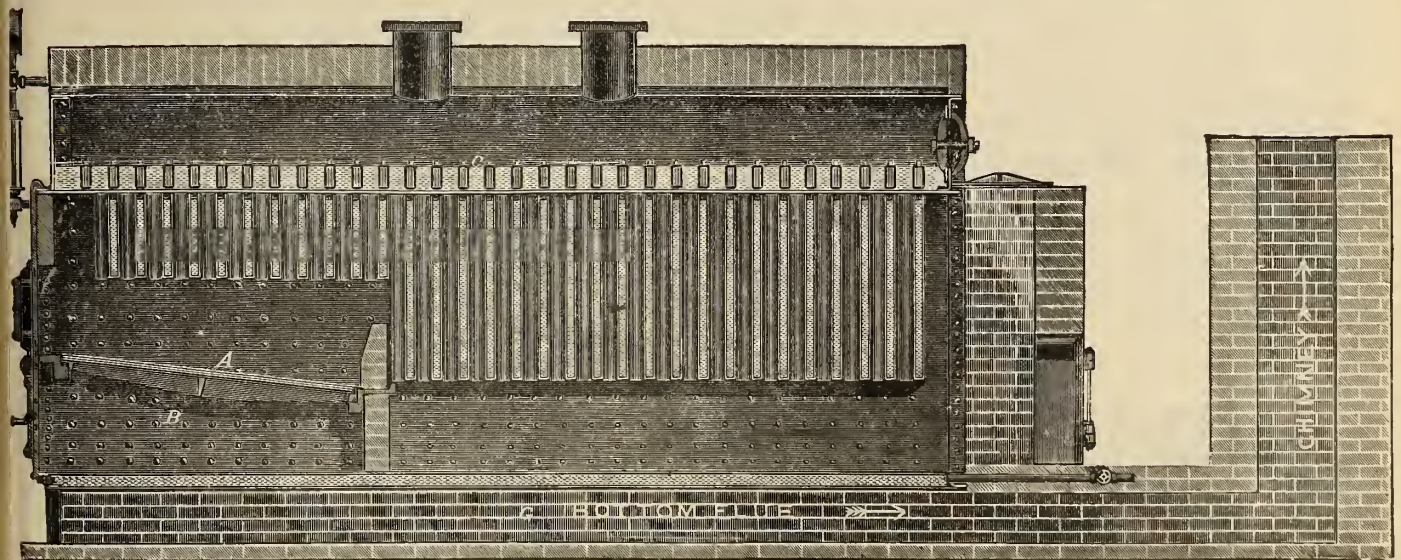
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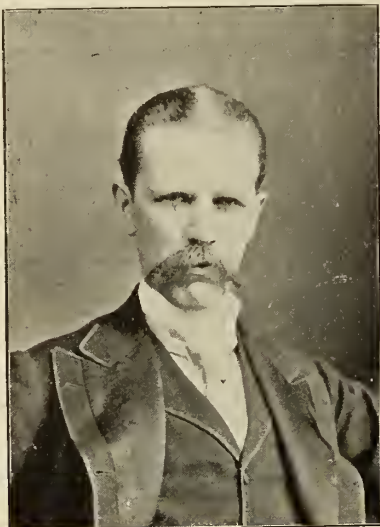
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PROF. C. A. CARUS-WILSON.

It is with much pleasure that we publish herewith a portrait and some particulars of Prof. Carus-Wilson, who recently resigned the McDonald chair of Electrical Engineering at McGill University, Montreal.

Prof. Charles Ashley Carus-Wilson is the youngest son of the late Rev. C. Carus-Wilson, Vicar of St. Mark's, Leamington, and grandson of the well known author and philanthropist, the Rev. W. Carus-Wilson, of Caster-ton Hall, Westmoreland. He was educated at Hailey-bury College and entered the Royal Indian Engineering College at Cooper's Hill, near Windsor, by a competitive examination. Two years later he gave up his position at the head of his year, and the certainty of a good ap-



PROF. C. A. CARUS-WILSON.

pointment in the service of the Indian government, in order to devote himself to electrical engineering at home, and subsequently in Paris, Brussels, Antwerp, Vienna and Bucharest, where he lighted up the palace of the king of Roumania. He then went to Cambridge, took his B.A. degree in honours (Natural Science Tripos) in 1887, and the M.A. degree in 1891.

After taking charge for three years of one of the laboratories at the Royal Indian Engineering College, Prof. Carus-Wilson was elected in 1890 to the Mc-Donald Professorship of Electrical Engineering at Mc-Gill University, Montreal. The electrical department of the University was not then in existence, and Professor Carus-Wilson carried through the work of organizing it and equipping the laboratories with great energy and success. The number of students taking this course is now very large, and a practical test of its results is afforded by the work of the graduates in applied science, many of whom already hold with credit important and responsible positions.

During the eight years in which Prof. Carus-Wilson has occupied this chair he has given much attention to original research, especially in connection with the direct current motor. The results of this are embodied in the volume of Electro-Dynamics which Messrs. Long-mans Green & Co., (London and New York) are now bringing out.

Prof. Carus-Wilson left Montreal in April last, and has since been giving a course of Cantor lectures in London on Electric Traction at the request of the Society of Arts.

In the words of the resolution passed by the Faculty of Applied Science at McGill University last April: "Prof. Carus-Wilson has aimed at founding a school of engineering of the highest type, and has made it both his duty and pleasure to encourage in the students that love of investigation which is the only real foundation for any true scientific work. His success as a teacher is best attested by the continued growth of the school and by the prominent positions occupied by graduates in the electrical course, while to the Chair of Electrical Engineering his special researches have given a greatly increased reputation."

MOONLIGHT SCHEDULE FOR AUGUST.

Day of Month.	Light.	Extinguish.	No. of Hours.
	H.M.	H.M.	H.M.
1....	No Light.	No Light.	.....
2....	No Light.	No Light.	.....
3....	No Light.	No Light.	.....
4....	No Light.	No Light.	.....
5....	P.M. 7.30	P.M. 10.00	2.30
6....	" 7.30	" 10.20	2.50
7....	" 7.30	" 10.50	3.20
8....	" 7.30	" 11.20	3.50
9....	" 7.30	" 11.50	4.20
10....	" 7.30	A.M. 12.40	5.10
11....	" 7.30	" 1.30	6.00
12....	" 7.30	" 2.20	6.50
13....	" 7.30	" 3.20	7.50
14....	" 7.30	" 4.20	8.50
15....	" 7.30	" 4.20	8.50
16....	" 7.30	" 4.20	8.50
17....	" 7.30	" 4.20	8.50
18....	" 7.30	" 4.20	8.50
19....	" 7.30	" 4.20	8.50
20....	" 7.30	" 4.20	8.50
21....	" 7.30	" 4.20	8.50
22....	" 8.00	" 4.20	8.20
23....	" 8.40	" 4.20	7.40
24....	" 9.20	" 4.20	7.00
25....	" 10.20	" 4.20	6.00
26....	" 11.20	" 4.20	5.00
27....	" 11.30	" 4.20	4.50
28....		" 4.20	4.20
29....	A.M. 12.00		
30....	No Light.	No Light.	
31....	No Light.	No Light.	

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PATENT RIGHTS.

THE American Stoker Co. have forwarded to us the following letter, with a request that it be printed in this number :—

The General Engineering Co. of Ontario, Limited, 80 Canada Life Building, Toronto, Ont.

DEAR SIRS,—The American Stoker Co., having an office at Room 54, Street Railway Chambers, Montreal, have submitted to us your circular letter, dated 26th May, 1898, and have also called our attention to an item which you caused to appear in the June number of the CANADIAN ELECTRICAL NEWS, in both of which it is stated that the American stoker now being introduced into Canada by the American Stoker Company is an infringement on certain alleged Canadian patents owned by you, and that as soon as the American stoker is installed in Canada, your solicitors have been instructed to take proceedings in the Exchequer Court of Canada against the user as well as against the manufacturer and importer, and warning the public against the use of the American stoker.

We are instructed by the American Stoker Company to inform you that the stokers manufactured by our clients are protected by Canadian patents, and are not an infringement of any patents legally held by your company.

We are also instructed to inform you that the American Stoker Company have sold and delivered five stokers to the Dominion Cotton Mills Company, and are about making delivery of stokers to other purchasers in Canada, and are prepared to defend any action for infringement or damages which may be brought by your company in virtue of such sales or the use which may be made by the purchasers of these stokers, and we are authorized to accept service of any legal proceedings which you may bring against the American Stoker Company. We have further to inform you that in the event of your company not making good your threats contained in your circular letter and in the article in the CANADIAN ELECTRICAL NEWS, within fourteen days from this date, both of which are calculated to deter prospective users of the stokers from purchasing from our clients, we are instructed by the American Stoker Company to institute legal proceedings against you for damages and for an injunction to restrain you from threatening legal proceedings on the ground of alleged infringement of patents. All other rights are reserved.

Your obedient servants,

MACMASTER & MACLENNAN.

The ratepayers of Hamilton will vote on the question of acquiring the street railway and operating it under municipal control. The questions submitted will be : (1) Shall the city now purchase the Hamilton Street Railway? (2) If the city does not now purchase the Hamilton Street Railway, should the council extend the franchise of the company for fifteen years—that is, until 1928?

SPARKS.

H. C. Baird & Son will probably put in an incandescent light plant at Parkhill, Ont.

The village of Beeton, Ont., has passed a by-law to raise \$3,500 for an electric light plant.

The Hull Electric Company were recently recommended by the coroner's jury to equip their cars with fenders.

Stuart & Harper, Winnipeg, Man., will supply and install a 150 light electric plant in J. Y. Griffin & Co.'s packing house, Winnipeg, Man.

The Electric Co. of St. Johns, Nfld., are increasing their plant, and have ordered a 150 horse power tandem compound engine from the Robb Engineering Co.

The special committee appointed to consider the question of the establishment of a civic electric light plant for the city of Hamilton have recommended that an expert be engaged to report on the subject.

An electric railway fare box which not only receives the ticket, but registers the fare, has been invented by E. B. Nagle, of Ottawa. The device is claimed to be simple, cheap and complete in every particular.

The Goldie & McCulloch Co., of Galt, offer prizes of from \$50 to \$100 for suggestions by their employees regarding the improvement of tools, machines, and for advanced ideas conducive to greater efficiency of the works.

The electric light station at Norwich, Ont., is about completed. It is a one-story structure, 25 x 52 feet, with storage addition. The power plant consists of an 80 h.p. boiler and 40 h.p. engine. The latter may be increased later.

A proposal is to be made to the city council of St. John, N.B., to secure legislation to take over the property, privileges and franchises of the St. John Street Railway Company, to be conducted by the city in the interest of taxpayers.

The agreement between the city of Brantford and the Brantford Electric and Operating Company for street lighting has been signed, the franchise being for ten years. It is said the company will expend immediately about \$10,000 in additional plant.

Mr. John Forman, of Montreal, has just completed the installation of 65 enclosed arc lamps in the store of John Murphy & Co. in that city. It is claimed that this is the first time that these lamps, lighted by an alternating current, have been used in Canada.

The Grand Falls Power Company have decided to proceed at once with the development of the water power of the Grand Falls of the St. John river, in New Brunswick. Senator Proctor, of Vermont; Mr. James Manchester, Mr. G. F. Baird and Col. H. H. McLean, of St. John, are interested in the project, and it is proposed to develop about 80,000 horse power.

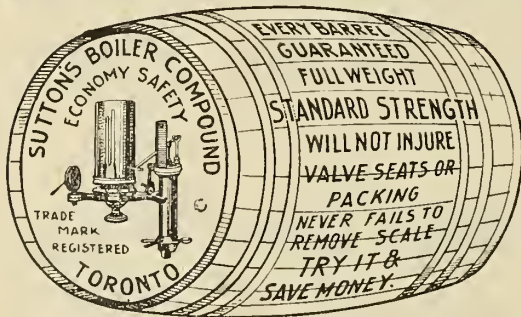
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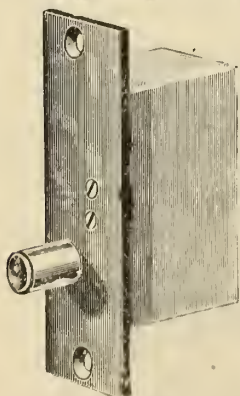
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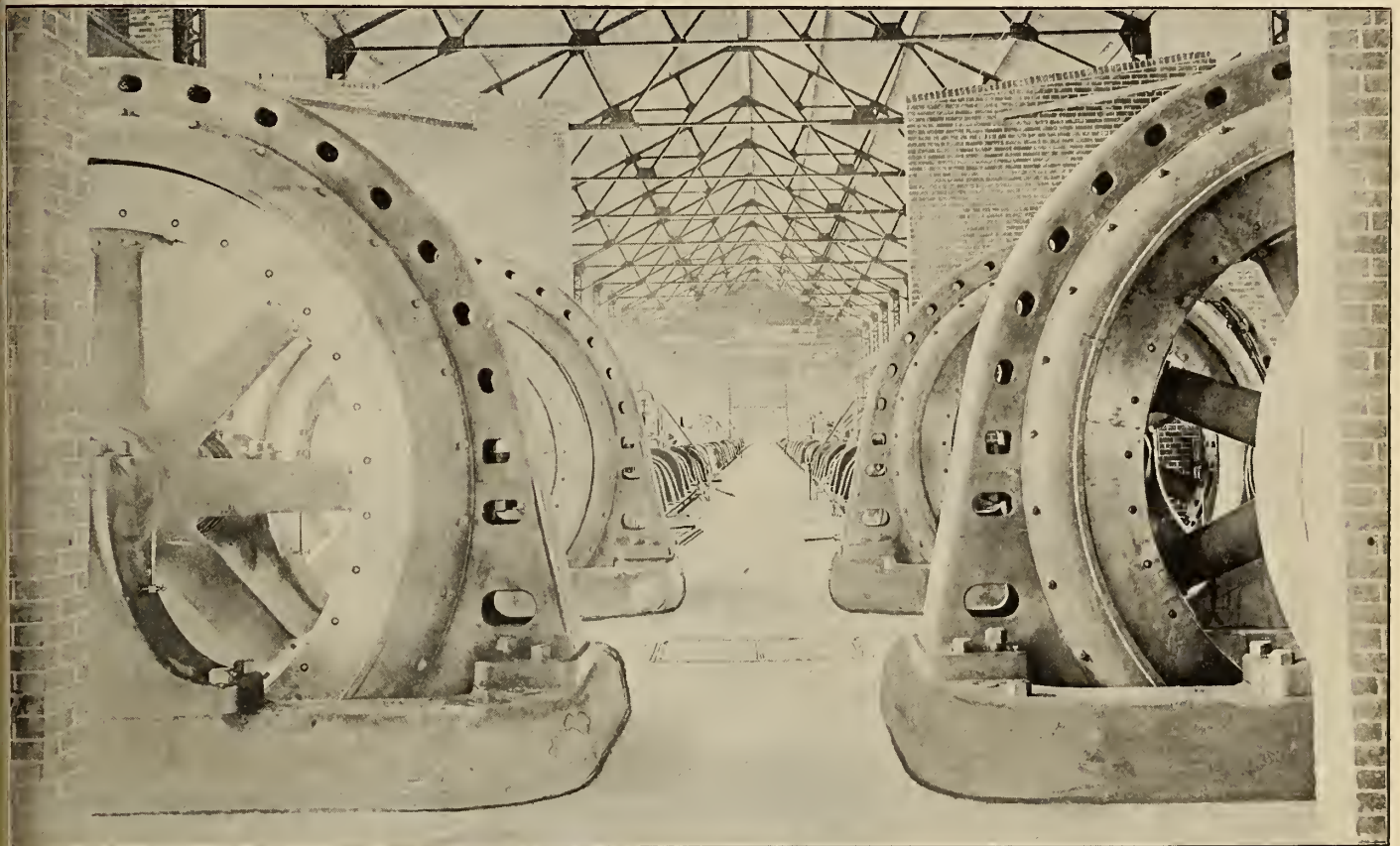
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THE Croftan Storage Battery Company, believing that Canada offered a profitable field for operations, have opened a branch at 22 Sheppard street, Toronto, Ont., where they are manufacturing storage batteries which they claim are superior to all others in lightness and efficiency, with an equal amount of durability. The battery is the result of five years' study and experiment by Dr. Croftan, a prominent physician of Chicago, assisted by Mr. J. K. Pumpelly, one of the best known storage battery experts in the United States, and the inventor of the Pumpelly Sorley cell.

In the construction of the Croftan plate chemically pure lead only is used, all foreign substances such as antimony being discarded, for the use of such substances (and they are quite commonly used) shortens the life of the battery, leading to rapid disintegration. The plate is formed of minute particles of lead, deposited to the desired thickness upon a perforated sheet of pure rolled lead by means of a spray, the perforated sheet having 8,100 perforations to the square foot. The sprayed lead forms perfect contact with the perforated lead, and is further secured by perfect union through the perforations. The plate is then run through a corrugating roller, by means of which interces are formed for the reception of further active material. Then, by means of an electro chemical process, the plates are converted into spongy lead, and peroxide plates are formed by further conversion of the spongy lead plates.

A plate is by this means formed whose entire surface is active material and whose "grid" or inactive portion is the perforated lead sheet in the centre, being less than 15% of the entire weight of the plate. All the joints in the battery are burned, no solder whatever being used; thus disintegration or sulphating at the joints is avoided.

The Canadian branch is under the control and management of Messrs. Rein Wadsworth and W. M. H. Nelles, with E. B. Arnold, a brother of B. J. Arnold, consulting engineer of the Electric Storage Battery Co. of Philadelphia, and W. L. Arnold, of the Siemens & Halske Electric Company of America, manager of the manufacturing department. The Croftan battery is claimed to be especially adapted for lighting plants and all work requiring the use of large storage batteries, while their smaller batteries, on account of their lightness and great efficiency, make a perfect cell for the use of doctors and dentists, and are most suitable for carriage lamps.

The Goldie & McCulloch Co., of Galt, Ont., have shipped a Wheelock engine, weighing 19,440 pounds, to the Montreal Belt Line Railway Co.

~ JAMES MILNE ~

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TRADE NOTES.

The Eugene F. Phillips Electrical Works, Limited, of Montreal, are supplying all the wire for the transmission plant of the Cataract Power Company, of Hamilton, which plant was described in our June issue. This order represents some 150 miles of wire.

La Compagnie Manufacturiers et Electrique de Montmagny have given an order to the Canadian General Electric Co. for a 100 k.w. monocyclic generator, which will be operated at a potential of 2,080 volts, together with the necessary station instruments for the operation of the plant.

The Hudson Bay Co. have given an order to the Canadian General Electric Co. for the installation of a complete lighting plant for their stores at Calgary. The plant will consist of one of the Canadian General Electric Co.'s latest four-pole type generators, having a capacity of 9 kilowatts. Messrs. Goldie & McCulloch Co., Limited, of Galt, are supplying the engine and boiler required for this installation.

The J. C. McLaren Belting Company, of Montreal, by means of a small folder, invited visitors to the Canadian Electrical Association convention to make an inspection of the belting in the generating station of the Montreal street railway system, transmitting 7,000 h.p. This belting, which was supplied by the above company, consists of twelve 24-inch three-ply belts. The number of hides used for its manufacture was 1,630, and the total weight of leather 15,000 lbs.



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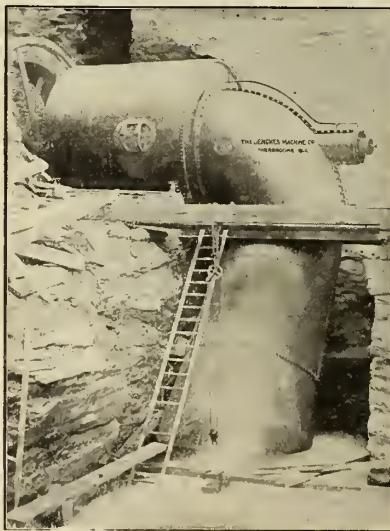


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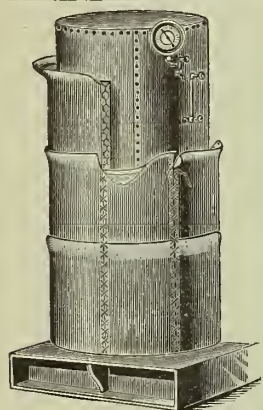
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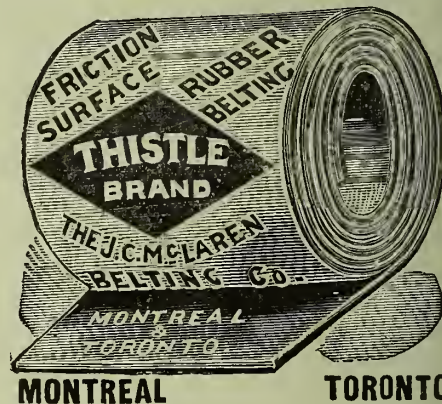
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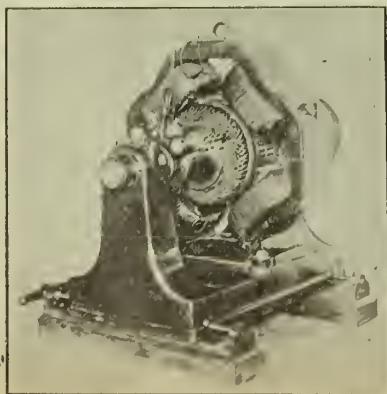
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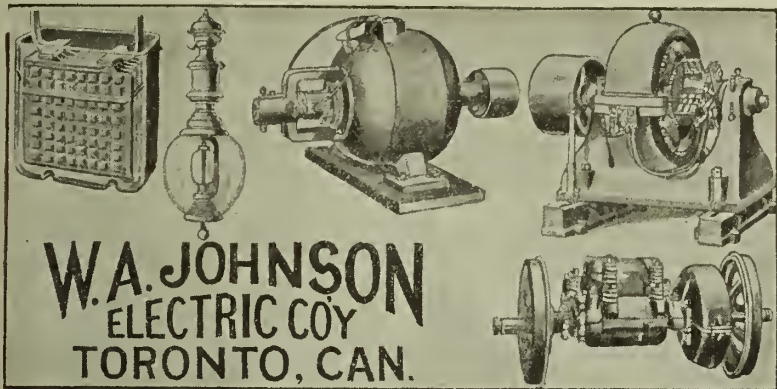
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NEW SERIES, VOL. VIII.—No. 8.

AUGUST, 1898

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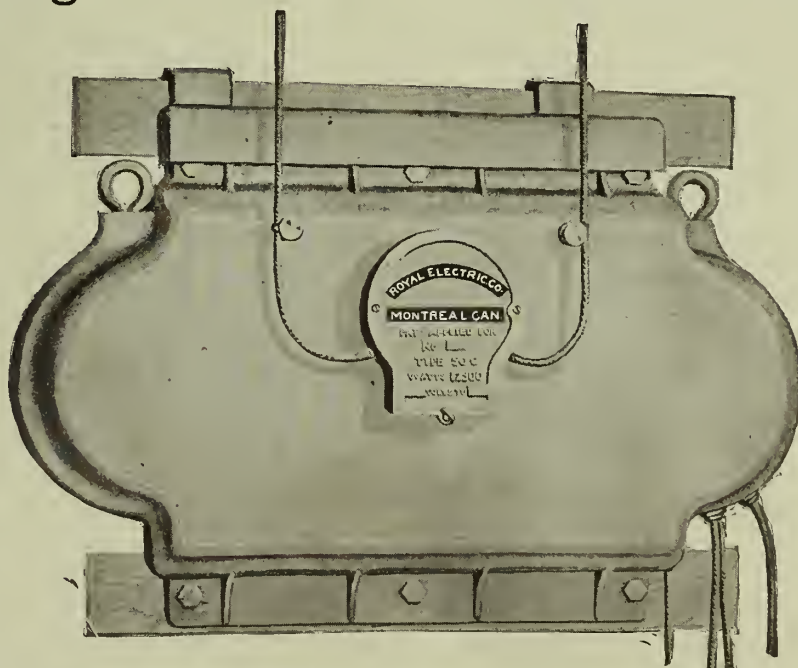
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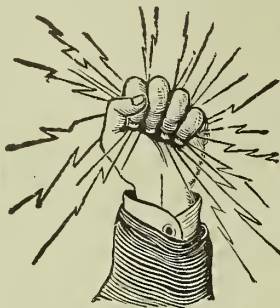
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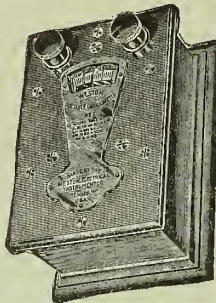
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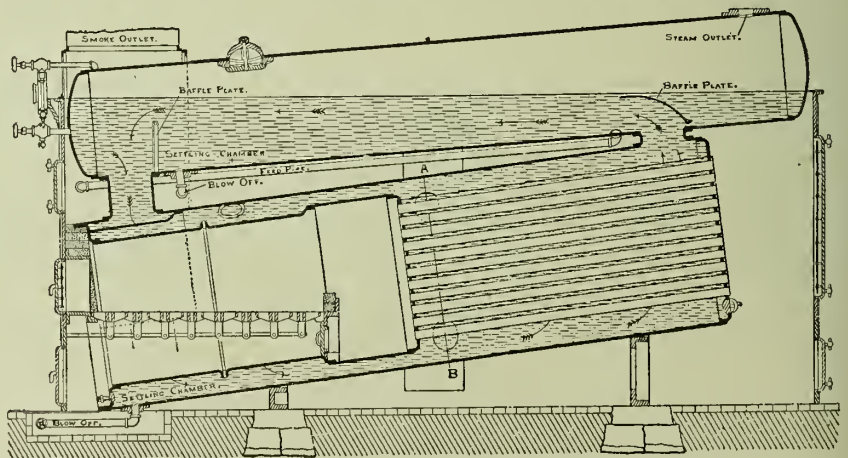
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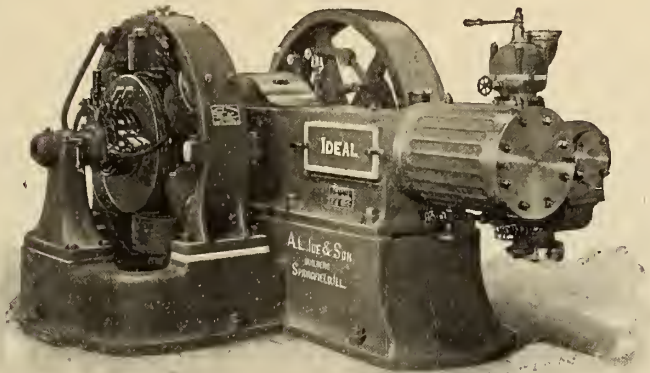
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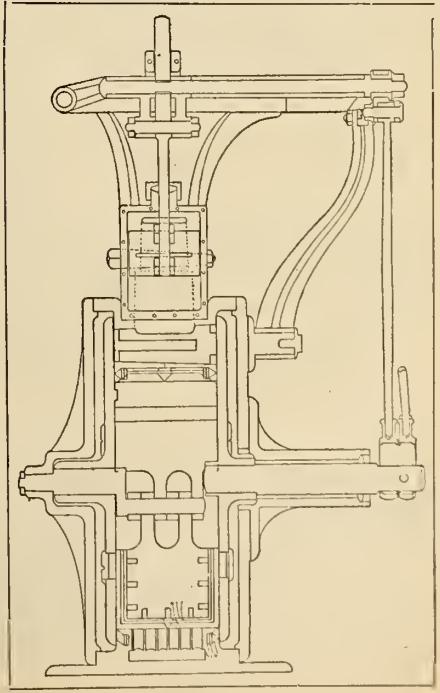
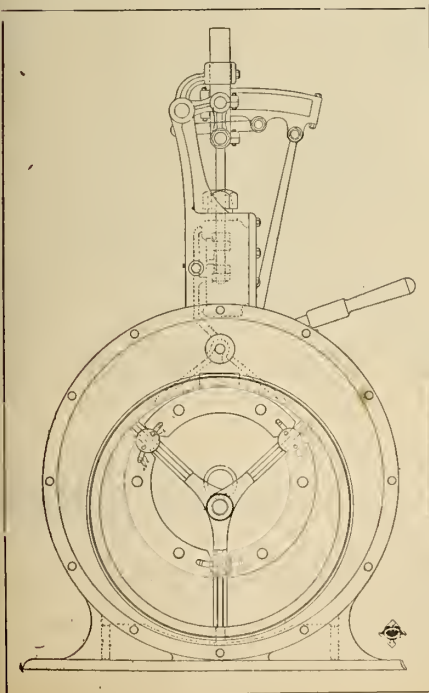
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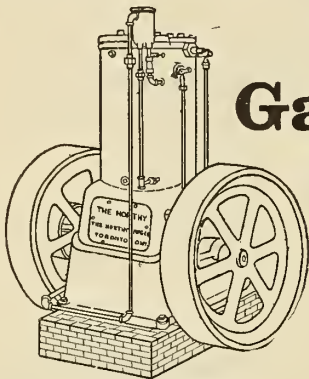
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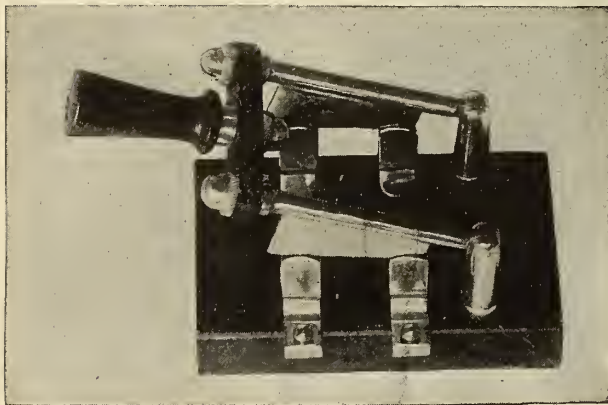
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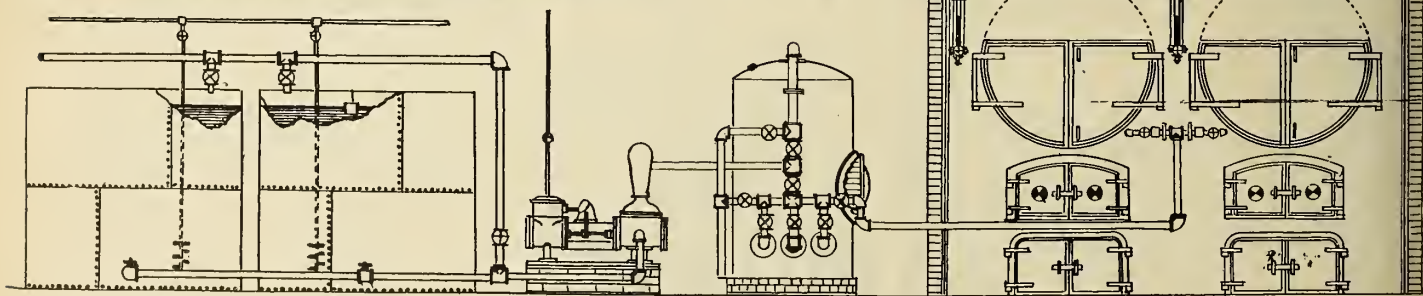
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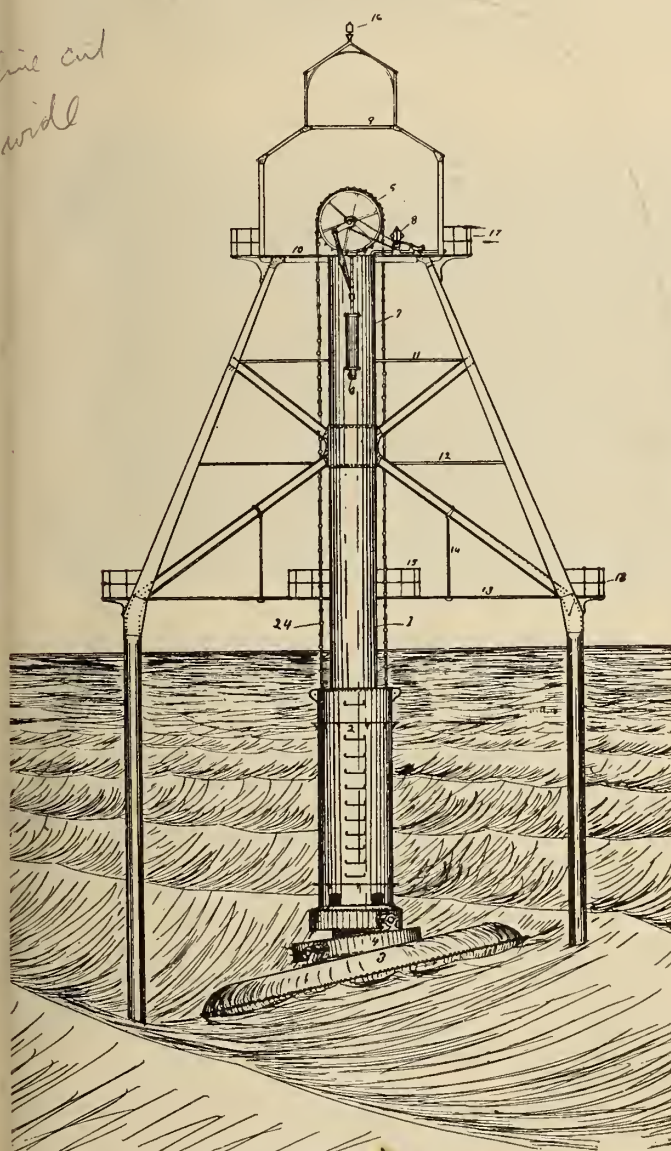
AUGUST, 1898

No. 8.

WAVE MOTOR.

Mr. Edward J. Ryan, of Milltown, Charlotte county, New Brunswick, has sent the ELECTRICAL NEWS drawings of a wave motor of which he is the inventor, and which he believes embodies many points of merit. The principle of the motor will be understood by reference to the accompanying illustrations, regarding which the inventor writes as follows :

Fig. 1 is a sectional view of the structure above water

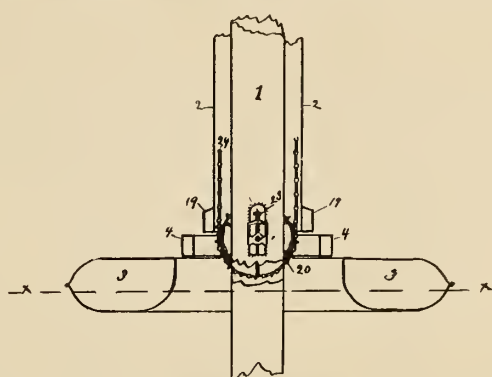


WAVE MOTOR—FIG. 1.

surface. 1, central stationary tube ; 2, truck tube ; 3, float ; 4, hoop ; 5, upper sprocket wheel ; 6, compressed air pump (there is another pump directly on other side of air tank) ; 7, air tank ; 8, pressure govern device ; 9, light room floor ; 10, floor on which one or more dynamos may be placed ; 11, pump and engine room floor ; 12, space on which dynamos can be placed, and to be used by the operators for their living apartments ; 13,

lower floor ; 14, hanging rods to support centre of lower floor ; 15, rail circling opening in lower floor ; 16, fog whistle ; 17, upper promenade ; 18, lower promenade ; 24, endless sprocket chain.

Fig. 2 is a sectional view showing lower sprocket wheel. It will be seen that the truck tube, 2, will play

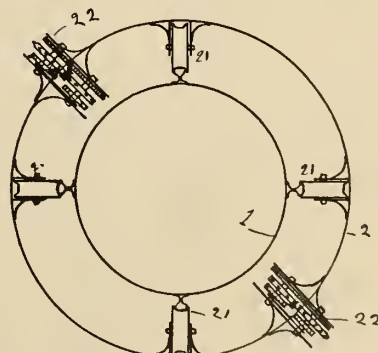


WAVE MOTOR—FIG. 2.

down by the lower sprocket wheel. 1 is stationary central tube ; 2, truck tube ; 3, section of float (x-x, water surface) ; 4, section of hoop ; 19, base section of truck tube ; 23, screw attached to lower sprocket wheel shaft bearings, to lift and lower the same ; 24, endless sprocket chain.

Fig. 3 is a top plan sectional view, showing the method of reducing friction of truck tube as it plays up and down on central stationary tube. 1 is central tube ; 2, shell of truck tube ; 21, rollers and rail ; 22, chain gripping devices.

Fig. 4 is a chain grip device, to grip the chain on the upward motion. These devices consist of a sprocket and a roller, between which the chain passes. The sprocket tooth passes through the chain and enters a recess in the roller, so the chain cannot slip. The



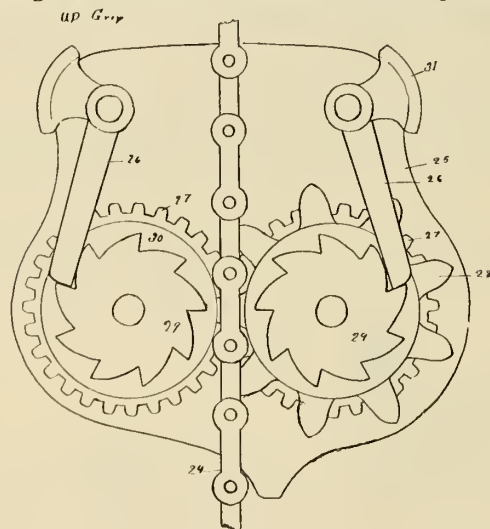
WAVE MOTOR—FIG. 3.

sprocket and roller shafts are provided with a cog wheel, which mesh together so that sprocket and roller will always turn together ; on the same shafts are placed a ratchet wheel, the same being provided with dogs. When these dogs are in position and the device is carried up, the chain must go with it, and when it descends the sprocket and roller will run down on the chain and

offer no resistance to it. When it is necessary to stop the chain, all that is required is to lift and throw back the ratchet dogs, and the device will offer no resistance to the chain either on the up or down motion. 24 is endless chain; 25, case plate; 26, ratchet dogs; 27, cog wheels; 28, sprocket wheel; 29, ratchet wheels; 30, roller; 31, weight on ratchet dogs.

Fig. 5 is view of down grip. This is just the same as the up grip, only the ratchet wheels and their dogs are placed in the opposite position. When the up grip has gripped and is carrying up the chain on one side, the chain is being drawn down on the other, and the down grip will offer no resistance to the chain. When the down grip has gripped and is carrying down the chain, the same is being drawn up on the other side, and the up grip will offer no resistance to the chain.

The machine is so different in construction from any yet produced that a number of experts have stated that they thought I had solved the problem of harnessing the ocean waves. I have produced the right sort of float, which is just as important a part of such a machine as the piston or steam valve is of the steam engine. The float being hung to truck tube in the way it is, assures a moderate up and down motion of the truck tube. If the float was fixed to truck tube stationary its motion would be different—it would have rapid starts very often. This was proven by an experiment. Another great fault if it were fixed stationary and the float was flat is that a wave would rise over its end and the same would come and go so quickly that it would pass over the float before the latter would rise; on the other hand, if the float was of any depth it would not rise so quickly, and it would offer great resistance to the surface. All this I have mastered by hanging my float on a pivot; an elevation of water will pass through my structure and slide under the float and find very little resistance. It will do this no matter from what direction the waves may come. I have provided my air tank with an automatic pressure governor, which insures a uniform pressure in

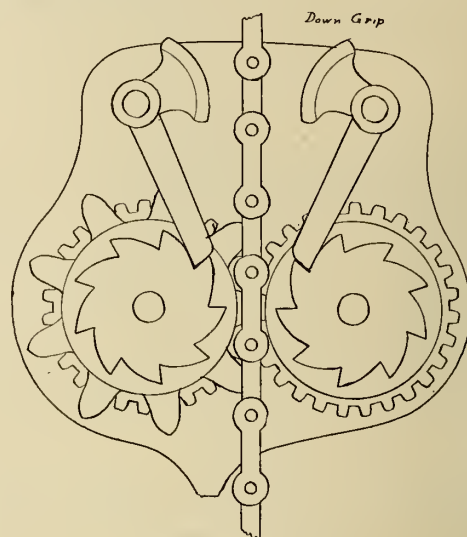


WAVE MOTOR—FIG. 4.

tank in all sorts of weather. The air tank is also provided with a safety valve.

I see in the ELECTRICAL NEWS that Mr. Wm. Cross thinks that Thos. A. Edison, jr., got his idea to harness wave motion from him. Now, I think that Edison's machine is no more like Mr. Cross's invention than day is like night. I would say that Edison's machine is more like my own than any other, and permit me to say through your columns that if Edison has copied from any person's machine it has been from mine, as you can judge from the following:

On the 19th day of October, 1897, I wrote, and sent a sketch showing the outside of my structure, to Mr. Thomas A. Edison, offering to send the detail drawings and to give him a half interest in the patent if he would furnish the capital to secure the same. I gave him no information of my working gear, but informed him of the one great tube running down through the centre of the structure. He returned my sketch after a time, and told me that he was so busy that he had no opportunity to look into the subject. Now, in the New York



WAVE MOTOR—FIG. 5.

Journal of January 14, 1898, there appeared the drawings and description of a wave motor, of which Mr. Thos. A. Edison, jr., was said to be the inventor, and it will be remembered that it stated that the development of the details of the plan was the work of a few months in the young wizard's mind. His motor consists of one great pump, the piston rod of which is connected direct to a float. It looks, without a doubt, that the Edisons thought that my central stationary tube was one great pump cylinder, and it also appears as though the young wizard found a little time to look into the subject.

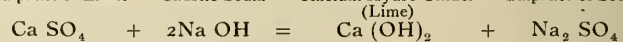
CORROSIVE AND SCALE-FORMING AGENTS IN BOILER FEED WATERS.

By WM. THOMPSON.

[ARTICLE 7].

ANOTHER commonly met compound of a similar type is one containing large percentages of caustic alkalis, usually crude caustic soda. The reaction between sulphate of lime held in solution and caustic soda is similar to reactions already cited.

Sulphate of Lime. Caustic Soda. Calcium Hydro-Oxide. Sulphate of Soda.



A similar reaction sets up between carbonate of lime and caustic soda. Water within the boiler soon becomes strongly alkaline and attacks brass and composite fittings very vigorously, also is very prone to foam; particularly is this the case if any saponifiable oil finds its way to the boilers. Compounds containing quantities of caustic soda in the absence of neutralizing agents can be with safety avoided.

Innumerable compounds have been introduced on the market containing organic acids, and some of these have good properties to recommend them. Chief among these are compounds containing "tannin" or tannic acid. Roger's process for the prevention of formation of scale consists essentially in the use of sodium tannate, which is a very useful reagent when properly made and applied. A reaction sets in between carbonate of lime and sodium tannate whereby insoluble amorphous tannate of lime is precipitated and sodium carbonate is formed, which in time acts upon any sulphate of lime present, reducing it to a carbonate of lime, thus leaving it in a position to be acted upon by a fresh supply of sodium tannate. Such reactions as these have sound chemical reasoning to recommend them. Care should be taken, however, that an excess of acid is not present in the solution, or damage to

the boiler will occur. If sodium tannate is at all pure and made by trained chemists the reaction should always leave sufficient alkali present within the boiler to counteract the injurious effect of free tannic acid.

It will be seen from the foregoing that boiler feed waters are subject to a wide range of impurities and in widely apart quantities, so much so that the use of no single boiler compound can be relied on to attain satisfactory results. Each particular case must have individual attention. Where methods of this kind have been adopted and practical experience has been brought to bear on the

through filter intervening between tank and boiler. While these tanks are a distinct aid to the efficient working of the filter, they are by no means an absolute necessity. Water could be passed directly from heater to pumps, thence through filter to boiler. With care in choice of a reagent a method of this kind ensures

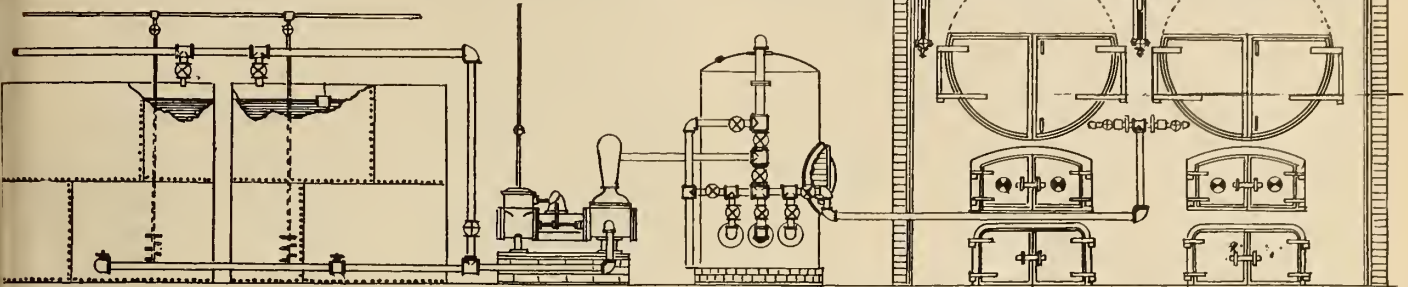


FIG. 1.

subject, wonderful success has been attained. This is evidenced by the almost remarkable success that has been attained by such men as Geo. W. Lord, whose compounds to-day stand so high in the annals of steam engineering that genuine compounds bearing this name are now accepted without question.

Treatment by chemicals aims to precipitate scale forming material as an insoluble, unhardenable sludge which can be easily separated from the water.

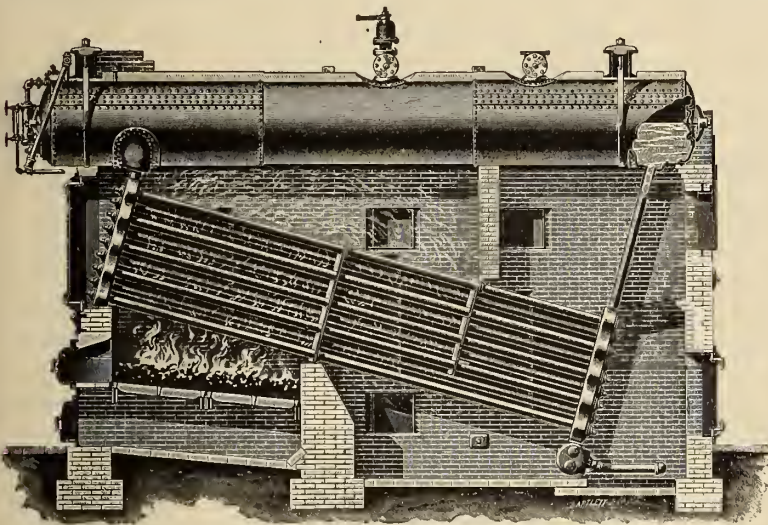


FIG. 2.

This method has very serious drawbacks, inasmuch as precipitation takes place within the boiler itself, and a thick pasty mass is liable to form directly over the fire box in certain styles of boilers of such a nature as to be quite as dangerous as the formation of the scale itself. We can then readily see that a successful method of dealing with scale forming waters demands both chemical and mechanical treatment—chemical treatment to precipitate scale forming agents, and mechanical treatment to extract this precipitate previous to delivering water to the boilers.

Every plant that makes any attempt at economy is provided with some means of heating feed water previous to delivering to boiler. The effect of this heater is to bring about a physical and chemical change on certain of the impurities contained by the water, and the presence of heat tends to aid precipitation and hasten the action of reagents; consequently all compounds should be fed into water gradually in sufficient quantity (previously determined) previous to water entering heater, when action will set in. Many of the manufacturers claim to extract the whole of the impurities at the heater by the simple addition of heat, while they are enabled, if a sufficiently high temperature can be reached, to cause precipitation of impurities. It is not quite as clear that this precipitate can be at once separated. Usually this precipitate passes over with the water to the boiler and is of an extremely fine nature whether chemical or physical means have been chosen to bring about precipitation. To prevent this a filtering arrangement, as shown in Fig. 1, is to be recommended.

This arrangement is intended to use two tanks of required capacity into which a definite quantity of reagent has been added and the whole is heated to about 212° Fah, water being fed from each tank alternately to boilers, sufficient time being allowed to lapse to complete chemical reaction before water is passed

clean boilers and successful treatment of waters otherwise unfit for boiler feed purposes.

Since, however, in bad waters filter is liable to be given a great deal of work, it is absolutely necessary that sure and quick methods for cleaning of filters are provided, and engineer requires to fully satisfy himself on this point before undertaking installation of a purifying plant on this principle.

In waters liable to throw down heavy precipitates in the absence of a filtering medium, or in small plants where capital investment becomes excessive for filtering apparatus, great care should be exercised in the choice of boilers. Construction should be such that all precipitates will deposit on lowest and coolest part of boiler at a point easily accessible and easily blown out. (See Fig. 2.)

This shows a type of boiler constructed with a view of securing precipitation of scale-forming impurities before water comes into actual contact with flues and plates of boiler exposed to high temperatures. Water containing the bi-carbonates of lime or magnesia or other salts that simply require heat to cause change of state from soluble to insoluble salts, being fed into the upper portion of boiler or portion used for steam drum, separation and precipitation would take place gravitating to lowest point or immediately behind baffle plate in front end of boiler, where blow-off is situated.

A type of boiler that has in the writer's experience given excellent satisfaction in this respect is illustrated in Fig. No. 3.

It will be noted that mud drum is provided at lowest point in this boiler, and placed in such a position that no actual contact with high temperature gases can occur; when waters have been treated as suggested, precipitate will follow current to lowest point and then settle. In this case mud drum acts as a receptacle for this precipitate, and being arranged in form indicated by cut, sludge or precipitate is concentrated in ready form for blowing out, and it has been the writer's privilege to have examined boilers of this type using waters that had been treated with chemical compounds and blow-off opened for a short time as occasion required to get rid of sludge, that were practically clean, although they had been in almost continuous use for nearly four months.

Both these boilers show distinctive types of mechanical ar-

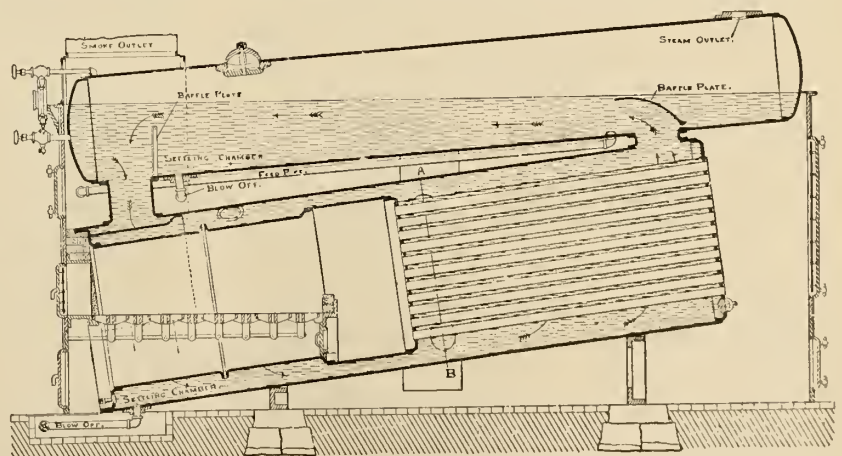
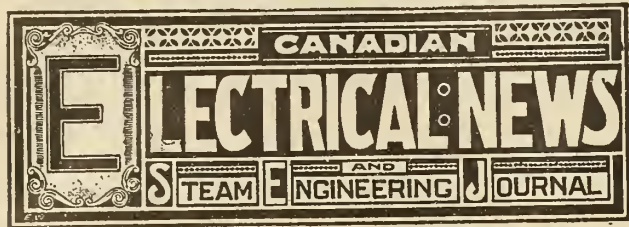


FIG. 3.

rangement designed to assist the water chemist in his work, and in closing these articles I wish to add my quota of thanks to the mechanical genius that enables this important question to be dealt with so successfully.

Mr. J. Walls, electrician, of Toronto, will have charge of the electric plant at Goldstream, B. C.



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TORONTO BRANCH NO. 1.—Meets 1st and 3rd Wednesday each month in Engineers' Hall, 61 Victoria street. Charles Moseley, President; H. E. Terry, Vice-President; J. W. Marr, Recording Secretary.

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MONTREAL BRANCH NO. 1.—Meets 1st and 3rd Thursday each month, in Engineers' Hall, 1863 Craig street. President, Geo. Hunt; 1st Vice-President, Wm. Ware; 2nd Vice-President, J. G. Robertson; Secretary, Henry Wilson; Treasurer, Thos. Ryan.

ST. LAURENT BRANCH NO. 2.—Meets every Monday evening at 43 Bonsecours street, Montreal. R. Drouin, President; Alfred Latour, Secretary, 306 Delisle street, St. Cunegonde.

BRANDON, MAN., BRANCH NO. 1.—Meets 1st and 3rd Friday each month in City Hall. A. R. Crawford, President; Arthur Fleming, Secretary.

HAMILTON BRANCH NO. 2.—Meets 1st and 3rd Tuesday each month in Macabec's Hall. Wm. Norris, President; G. Mackie, Vice-President; Jos. Ironside, Recording Secretary, Markland St.

STRATFORD BRANCH NO. 3.—John Hoy, President; Samuel H. Weir, Secretary.

BRANTFORD BRANCH NO. 4.—Meets 2nd and 4th Friday each month. J. B. Forsyth, President; Jos. Ogle, Vice-President; T. Pilgrim, Continental Cordage Co., Secretary.

LONDON BRANCH NO. 5.—Meets on the first and third Thursday in each month in Sherwood Hall. Duncan McKinley, President; William Blythe, Vice-President; W. Allan, Secretary.

GUELPH BRANCH NO. 6.—Meets 1st and 3rd Wednesday each month at 7.30 p. m. H. Geary, President; Thos. Anderson Vice-President; H. Flewelling, Rec.-Secretary; P. Ryan, Fin.-Secretary; Treasurer, C. F. Jordan.

OTTAWA BRANCH NO. 7.—Meet every second and fourth Saturday in each month, in Borbridge's hall, Rideau street; Frank Robert, President; T. G. Johnson, Secretary.

DRESDEN BRANCH NO. 8.—Meets 1st and Thursday in each month. Thos. Steeper, Secretary.

BERLIN BRANCH NO. 9.—Meets every Friday evening. G. Steinmetz President; J. Heyd, Vice-President; W. J. Rhodes, Secretary, Berlin, Ont.

KINGSTON BRANCH NO. 10.—Meets 1st and 3rd Thursday in each month in Fraser Hall, King street, at 8 p. m. President, F. Simmons; Vice-President, C. Asselstine; Secretary, J. L. Orr.

WINNIPEG BRANCH NO. 11.—President, G. M. Hazlett; Rec.-Secretary, J. Sutherland; Financial Secretary, A. B. Jones.

KINCARDINE BRANCH NO. 12.—Meets every Tuesday at 8 o'clock, in McKibbin's block. President, Daniel Bennett; Vice-President, Joseph Lighthall; Secretary, Percy C. Walker, Waterworks.

PETERBOROUGH BRANCH NO. 14.—Meets 2nd and 4th Wednesday in each month. W. L. Outhwaite, President; W. Forster, Vice-President; A. E. McCallum, Secretary.

BROCKVILLE BRANCH NO. 15.—Meets every Monday and Friday evening, in Richards' Block, King St. President, John Grundy; Vice-President, C. L. Bertrand; Recording Secretary, James Aikins.

CARLETON PLACE BRANCH NO. 16.—Meets every Saturday evening. President, Jos. McKay; Secretary, J. D. Armstrong.

ONTARIO ASSOCIATION OF STATIONARY ENGINEERS.

BOARD OF EXAMINERS.

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Information regarding examinations will be furnished on application to any member of the Board.

Boiler Explosion at Sycamore.

THE recent boiler explosion in a saw-mill at Sycamore, Ont., by which the lives of four men were sacrificed,

again emphasizes the necessity of compulsory inspection of boilers, and of having reliable engineers in charge of same. That public opinion is growing in this direction is shown by the recommendation of the coroner's jury that boiler inspectors be appointed and that engineers be compelled to hold certificates of competency. The jury, in their report, state that the explosion was caused by the pressure on the boiler being too great, which may be interpreted to mean that the accident might have been avoided by the exercise of more precaution and skill. In view of the number of explosions similar to that referred to above, the legislation which the Canadian Association of Stationary Engineers is seeking to obtain should, in the public interest, be heartily supported.

The Freight Transportation Problem.

REFERRING to the tramway paper presented by Mr. W. T. Bonner before the Canadian Electrical Association, the Electrical Engineer, of New York, says: "We are interested to note that at the recent meeting of the Canadian Electrical Association, serious attention was drawn to a plan for the standardization of farm wagons in such a way that they could be taken aboard bodily by trolley trucks and thus hauled to and from market. At first blush this looks like a rather wild project, but we confess we can see no good reason why some such plan should not be carried out in every rural region now tapped by a trolley service. The lessening of the cost for haulage and of loss from spoilage would be enormous; the trolley would open up a new country and a new source of income; the rates would be so low as to encourage the development of new lines of cultivation, and the ties between town and country would be more closely

knit than ever. These things will come and must come soon, with electricity as the prime factor in their coming."

ANNOUNCEMENT of the fact that an electric plant of 20,000 h.p. capacity is to be immediately installed at Sault Ste. Marie, to operate the electric furnaces for the manufacture of nickel steel, for use in the Krupp gun and armor works at Essen, Germany, is a striking indication of the important part which electricity is to play in metallurgical operations and in mining development in the future. It is a fortunate circumstance that the practicability of the long distance transmission of electrical energy by water power for the operation of machinery and the extraction of valuable ores, should have been demonstrated simultaneously with the discovery of many valuable mining deposits in North Ontario and British Columbia. In the latter province a large amount of electric machinery has recently gone into use in mining operations, for rock crushing, hoists, tramways, etc., and is largely assisting to make possible the rapid development of the national resources.

Wiring Rules. In the discussion which took place at the recent convention of the Canadian Electrical Association, the fact was established that managers of electric companies are being subjected to much unnecessary annoyance and expense for lack of a uniform system of rules authorized by the Underwriters Association which should govern methods of electric wiring in all parts of Canada. It was likewise pointed out that in connection with such a uniform system there should exist one central authority to whom all questions in dispute between the companies and the inspectors might be referred, and whose interpretation of the regulations and decisions on disputed points should be accepted as final. At present the regulations differ as between one province and another, and even as between the inspection divisions of a single province, while each inspector interprets for himself the meaning of the particular set of rules under which he works. A wireman who has learned his business in Ontario, on removing to Quebec, finds himself confronted by regulations and methods differing so widely from those to which he has been accustomed that he is almost obliged to learn the business over again in case he is fortunate enough to be able to secure employment. The electrical companies claim that owing to unnecessary restrictions imposed by the underwriters the development of the industry has been retarded. To what extent this is the case we are not prepared to say. No one having the welfare of the industry at heart would wish to see relaxed any regulation necessary to the performance of work in a scientific, safe and substantial manner, but care should be taken to avoid imposts which, while not essential to this object, give rise to uncertainty, dispute, annoyance and expense. We have no doubt that as the result of the conferences which are to be held between the committee of the association appointed for the purpose and the underwriters, many at least of the causes of objection urged against the present wiring regulations will at an early date be removed. The Canadian Electrical Association is demonstrating its usefulness by dealing with this and other questions of like importance affecting the electrical interests, and is thereby commending itself to the sympathy and support of the electrical companies. Such questions may

be expected to continually arise, and they can only be satisfactorily dealt with by an organization representing the interests involved.

Hazards of Acetylene Gas.

FIRE underwriters are still watching with no little concern the results following the use of acetylene gas as an illuminant, and from their observations and research are adopting rules to govern its use. Wherever the subject has been given attention, it has been found necessary to place stringent restrictions upon the employment of this gas. The National Board of Fire Underwriters of the United States have approved of a set of rules, based upon a special investigation of acetylene gas made by Prof. Henry Morton, of the Stevens Institute of Technology. These rules provide that the generating apparatus be situated in an outside fireproof building, that no artificial light be used in such building, and that the storage of liquid acetylene in any building, or the use of liquid acetylene gas, be absolutely prohibited. Mr. F. M. Griswold notes, in the Insurance Press, some of the physical characteristics of calcium carbide and acetylene gas as developed from investigations conducted by a number of European and American professors, and which are therefore of much significance. Commenting upon these characteristics, Mr. Griswold says: "The resume clearly demonstrates that grave fire explosive hazards are inherent to both calcium carbide and acetylene gas under conditions liable to supervene in every-day practice, as now permitted by some of the insurance organizations throughout the country, and it is high time that some concert of action be had by the insurance interests to secure the adoption of rules and regulations which, while granting the broadest latitude consistent with safety, will not unduly hamper the vendor, nor prove too onerous for profitable use of the apparatus by the purchasers." To convince some parties of the possibility of attaining high temperatures in the generation of acetylene gas from calcium carbide, Mr. William DeWitt, inspector for the Philadelphia Fire Underwriters' Association, made a test on June 18th last. Fifty pounds of carbide were bought in the open market, and one-half of same placed in a barrel open at one end. At 8 a.m. these twenty-five pounds were soaked with water and the gas allowed to escape; then the balance of the carbide (twenty-five pounds) was placed on top of the first and pressed down, the intention being to produce conditions which would probably be met with should carbide on storage or under shipment become wet from the bottom, but the whole quantity not water soaked. Six hours later, at 2 p.m., smoke from burning wood was found to be issuing from between the staves of the barrel, and at 3 p.m. the barrel staves were in flames at the bottom. After smothering the fire, it was discovered that the bottom of the barrel had been entirely consumed.

S. C. Drummond, representing the British Electric Traction Co., of London, Eng., has applied to the town council of Nelson, B. C., for a charter for an electric street railway. The council has signified its willingness to grant the application on suitable terms.

A deputation of Toronto gentlemen approached the town council of Paris, Ont., recently on the subject of the construction of an electric railroad between that town and Ayr. It is understood that a charter has been applied for. A company is also seeking a charter under the name of the Grand River Electric Light and Power Co., to construct a stone dam across the river at Mr. Cavan's farm, with the object of supplying light and power. Mr. Fair, of Brantford, is the company's engineer.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

NOTE.—Secretaries of Associations are requested to forward matter for publication in this Department not later than the 6th of each month.

TORONTO NO. 1.

Toronto No. 1 have elected new officers as follows : President, Charles Moseley ; vice-president, H. E. Terry (acclamation) ; recording secretary, J. W. Marr (re-elected) ; financial secretary, A. Stute ; treasurer, S. Thompson (re-elected) ; conductor, W. Clarke ; door-keeper, J. C. Long ; trustees, J. Fox, J. Huggett and W. Webb ; delegates to the annual convention, J. Fox, C. Moseley, W. Webb, A. M. Wickens and T. Eversfield.

MONTREAL NO. 1.

The first annual meeting of Montreal No. 1, since their removal to their new hall, 1863 Notre Dame street, was held on the evening of June 20th. The auditor's report for the fiscal year showed that the association was fairly prosperous financially, having a credit balance for the year. The election of officers for the coming year resulted as follows : President, Geo. Hunt ; first vice-president, Wm. Ware ; second vice-president, J. G. Robertson ; treasurer, Thos. Ryan ; secretary, Hy. Nuttall ; conductor, W. Wadey ; doorkeeper, J. Huntingdon ; librarian, F. Thompson ; corresponding secretary, P. McNaughton.

LONDON NO. 5.

At the last meeting of London No. 5 the election of officers took place. The result was as follows : Duncan McKinley, president ; William Blythe, vice-president ; G. B. Risler, treasurer ; W. Allen, corresponding secretary ; W. Meaden, minute secretary ; James Harding, conductor ; Henry Geldart, guard. The installation of officers was carried out in a very efficient manner by the past president, J. D. Campbell. Some questions were asked and discussed. The heating surface of a tubular boiler, 60 in. in diameter by 12 ft. long, with 84 3-inch tubes, was figured out on the blackboard by the past presidents, which was followed by a general debate on the water consumption per indicated horse power.

MOONLIGHT SCHEDULE FOR SEPTEMBER.

Day of Month.	Light.	Extinguish.	No. of Hours.
	H.M.	H.M.	H.M.
1....	No Light.	No Light.	.....
2....	No Light.	No Light.	.....
3....	P.M. 7.00	P.M. 9.20	2.20
4....	" 7.00	" 9.20	2.20
5....	" 7.00	" 9.50	2.50
6....	" 7.00	" 10.40	3.40
7....	" 7.00	" 11.30	4.30
8....	" 7.00	A.M. 1.00	6.00
9....	" 6.40	" 1.10	6.30
10....	" 6.40	" 2.10	7.30
11....	" 6.40	" 3.10	8.30
12....	" 6.40	" 4.20	9.40
13....	" 6.40	" 4.30	9.50
14....	" 6.40	" 4.40	10.00
15....	" 6.30	" 4.40	10.10
16....	" 6.30	" 4.40	10.10
17....	" 6.30	" 4.40	10.10
18....	" 6.30	" 4.50	10.20
19....	" 6.30	" 4.50	10.20
20....	" 7.20	" 4.50	9.30
21....	" 8.20	" 4.50	8.30
22....	" 9.20	" 4.50	7.30
23....	" 10.30	" 4.50	6.20
24....	" 11.00	" 4.50	5.50
25....	" 11.40	" 4.50	5.10
26....	.....	.....	.....
27....	A.M. 1.00	" 4.50	3.50
28....	No Light.	No Light.	.....
29....	No Light.	No Light.	.....
30....	No Light.	No Light.	.....

Total..... 171.30

LEGAL.

BELL TELEPHONE COMPANY VS. CITY OF HAMILTON.—The Bell Telephone Company appealed from the decision of a board of three county judges affirming the decision of the Court of Revision for the city of Hamilton, whereby the assessment of the appellants for 1898 was confirmed. The part of the assessment in question upon this appeal was that upon the poles, wires and conduits of the appellants, at \$13,490. The appellants complained of the assessment of these articles as real estate, and also contended that it was excessive, the value for assessment being determined by taking the gross cost and deducting 15 per cent. for wear and tear. The Court of Appeal held that the equipment could only be taxed for their abstract value as raw material.

TRENTON ELECTRIC COMPANY VS. TOWN OF TRENTON.—This suit was brought for damages for breach of an agreement between plaintiffs and defendants, for specific performance of the agreement, and for a declaration of rights. The agreement contained no assent in express words to the plaintiffs placing their poles in the streets or stretching their wires across them ; but the trial judge held, having regard to the method ordinarily adopted for transmitting the electric current, that it must be taken that defendants impliedly granted to plaintiffs such rights for these purposes as might be reasonably necessary to enable plaintiffs to carry out their engagements and to enjoy the rights conferred upon them, but there was nothing in the agreement to indicate that the purposes which the contracting party had in view were other than local and confined to the limits of the town, and the defendants could not be taken to have assented to the contract which would enable plaintiffs to use the power, which defendants had acquired at great expense, in order to build up their own town, for the purpose of promoting the interests of a rival municipality, and therefore plaintiffs were not entitled to transmit their power to Belleville. The Court of Appeal agreed with the Chief Justice's view and dismissed the appeal with costs.

HULL ELECTRIC CO. VS. OTTAWA ELECTRIC COMPANY.—The Hull Electric Company instituted an action in the Superior Court to compel the Ottawa Electric Company to remove its electrical apparatus from the city of Hull, and to cease supplying electricity to Hull and the people therein, and claiming \$20,000 damages. The Ottawa Electric Company contended that it also had obtained from the city of Hull the privilege of supplying electricity there ; that this privilege was granted to the Ottawa company previous to the grant to the Hull company ; that the Hull company did not and could not have an exclusive privilege ; that if the legislature of Quebec granted such exclusive privilege it was ultra vires of the said legislature. Mr. Justice Lavergne maintained the defendants' contentions. He held that the exclusive privilege claimed by the Hull Electric Company is ultra vires, null and void ; that the local legislature exceeded its powers in attempting to give to the Hull company the exclusive privilege claimed by the latter ; that electricity is a commercial commodity, the sale and supply of which cannot be given exclusively to any person or corporation ; that the federal government alone has the power of granting such privilege or franchise. The action was consequently dismissed with costs.

PATENT RIGHTS.

THE General Engineering Company of Ontario, Limited, manufacturers of the Jones' underfeed stoker, have taken action in the Exchequer Court against the Dominion Cotton Mills Co., of Montreal, for having in use in their establishment a device which is claimed to be an infringement of the plaintiffs' patent rights.

Plaintiffs claim as follows : 1. That the defendants, their agents, servants and workmen may be restrained by injunction during the continuance of each of the said letters patent, from making, constructing, using or vending to others to be used in the Dominion of Canada, any boilers, furnaces or mechanical stokers, made according to or in the manner described in the specification of such respective letters patent or according to or in manner only colourably different from the same, and generally from infringing the rights of the plaintiffs in respect of such letters patent. 2. That the defendants and each of them may be ordered to deliver up to the plaintiffs all such boilers, furnaces and mechanical stokers as aforesaid, as are in possession or power of the defendants. 3. That the defendants may be ordered to pay damages to the plaintiffs for the infringement of their said patent rights. 4. That the defendants may be ordered to pay the costs of this action. 5. That the plaintiffs may have such further or other relief as the nature of the case may require.

Mr. Terence Cunerty has been appointed engineer at Osgoode Hall, Toronto.

A company is being formed at Brantford, Ont., to construct an electric road between Waterford and Port Dover.

The village of Campbellford, Ont., has voted in favor of raising \$8,000, for the purchase of an incandescent lighting plant, to replace the one now in use.

DAY LOAD FOR CENTRAL STATIONS.

By "ECONOMY."

How to obtain the greatest possible return for a given capital expenditure is a problem that interests investors in all lines of business, and not exclusively electric stations. It is one, however, that possesses a special interest for electrical investors, because, if their business be confined solely to lighting, then their whole investment is earning money during only a portion of each twenty-four hours, is not running for any considerable time at anything like full efficiency, and has yet to pay interest, depreciation and all other fixed charges, all day and every day. If the prices obtainable for electric light were not so very much affected by competition from gas, the matter of obtaining some extension of business for the plant would not assume such great importance; as it is, however, every means of increasing income without proportionately increasing expenditure should be thoroughly investigated. An electrical power house has four possible sources of income—light, power, heat and current for electrolytic purposes—and whether these are possible practically or only theoretically depends solely on local conditions. Before considering the several possible features of a day load, it may be as well to consider why such a load is deemed to be advantageous—what is the benefit (pecuniary, of course) to be derived from it?

In every central station there are certain fixed expenses, such as depreciation, taxes, insurance, interest on bonds, etc., that have to be provided for by the operation of the plant; and in a purely lighting plant, operating only about twelve hours on the average per day, the proportion of such fixed expenses borne by each 24 hours has to be provided by each 12 hours' run; or, one hour's run has to earn two hours' fixed expenses. If, now, work could be obtained for the plant during 16 hours, then the strain would be reduced, for one hour's operation would only have to earn $1\frac{1}{2}$ hours' expenses, and so on. Another way of looking at the same question is that, assuming a certain more or less definite aggregate station output for each 24 hours' run, this aggregate amount can be generated in 18 hours' running by a smaller amount of machinery (and therefore at a lower charge for fixed expenses) than would be required for generating it in a 12 hours' run. Or, putting the matter broadly, the "time-efficiency" of a plant is greater the longer it runs per day.

The matter is, however, greatly complicated for the larger number of the central stations in the Dominion, by several very practical considerations; and it becomes a point for very careful investigation as to whether in any particular case a day-load is an advantage or very much the reverse. In the present state of the electrical manufacturing industry, it is open to doubt as to whether there is a really satisfactory and efficient single phase alternating current motor; and as the conditions in which direct current for distribution is equally as good an investment as alternating current are somewhat rare in our smaller towns, the day load of motors to be worked up must be sufficiently great to counter-balance the pecuniary loss sustained by distributing with direct current at a higher first cost. And, moreover, where a plant supplies both a power and a lighting load, it is evident that during the winter months the lighting, commencing at about 4 p.m., will overlap the power, which does not stop till 6 p.m. In this case either the two forms of load must come off the same mains, feeders, generators and engines, in order that the size of plant may be kept down, or else the two plants must be kept separate and distinct down to the boilers, at an increased cost for apparatus. In the former case any momentary fluctuation of the power load, acting through the distributing and generating system, will inevitably have an effect on the quality and steadiness of the lighting, which will vary according as the lighting or the power load is greater. In the latter, the duplication of all the necessary apparatus leaves the power question to be solved on the same basis as the lighting question, i.e., "Is there enough business to be done to make it a paying investment?" It may be taken for granted that no extensive, or even moderately large power business can be satisfactorily done by single phase motors. These can at best be regarded merely as an expedient—bad at the best—so the matter remains between d. c. distribution and polyphase, and comes down ultimately to the above result.

In summer time, no doubt, the power load will come off before the lighting commences, so that the same machinery will perform double duty, the only extra expense being for day wages and for fuel. But just as soon as the afternoons get short, and lighting starts up earlier and earlier, then the services will overlap, and there will have to be enough generating machinery for both combined. Looking at it in this way, there doesn't seem to be much advantage in working up a small day load, which will require extra

machinery and day wages, and in probably the majority of cases it would not pay at all. But the operating industry has now arrived at a stage where it becomes advisable to investigate all these questions, and accept the results arrived at, even if they involve remodelling entire systems at considerable expense.

In most towns there will be found a waterworks system using direct pressure by means of pumps with or without storage tank. This will often afford a nucleus of a day load which may be profitably added to. Insurance requirements generally are that a certain hydraulic pressure shall be kept over the whole piping system night and day, which, of course, requires two shifts of engineering staff. An electric company having already a night shift provided, would only require a day shift to do this service, and could probably make arrangements with the town authorities for running the waterworks, which would save the town so much in wages alone as to make it good business for them to contract with the company, and yet have a good margin of profit for the company.

Arrangements could probably be made so that the electric plant could be placed in a building adjacent to the pump-house, and the two services combined under the one staff. The pumps could either be operated by steam as usual, or else (and preferably) electric pumps could be used. In this latter case it is probable that a considerable fuel economy could be effected, as the combined efficiency of an expansion engine, a high class generator and motor, would exceed that of a steam pump, which is not recognized as a very efficient steam-using apparatus. Thus the town would save the expense of an entire engineering staff and fuel, while the company would have a paying nucleus for a day load. Even though the two plants could not be combined in the same building, the pumps could be operated electrically, and a sufficient price obtained for the service to pay all expenses and leave a little over. Waterworks that use a stand-pipe generally arrange to do a certain number of hours' pumping during the 24 hours, leaving the pipe to supply the demand during the rest of the time. This presents a particularly favorable case for the electric company, for then it is always possible to do the pumping during daylight hours, between 9 a.m. and 4 p.m., except in the "lawn" season, when it will begin at say 6 a.m. and go on to 6 p.m. But then at this season lights are not required till later in the evening. So that this case allows of the station plant being run during a longer time every day, doing pumping and lighting with the same boiler and engines, and perhaps even the same generators, if they are either d.c. or polyphase alternating.

The mere pumping business may or may not be worth while undertaking, depending on the price, but if there is any other power business to be done in the town at all, it at least provides the machinery and engineer, and the rest can be undertaken on a thoroughly satisfactory basis. Even in this favorable case, however, it will be inadvisable to run motors off the regular lighting circuits, for two if not more reasons. First, unless the lighting be done solely on the meter basis, there will always be a certain number of persons who will allow their lamps to burn all day, simply because they "don't pay anything extra for it," which means unnecessary fuel consumption; and second, because in winter time, the loads overlapping, any fluctuation in the motor load from moment to moment will have an effect on the lights, causing them to flicker. If the proportion of the total motor load to the lighting load be large, and there be any units of considerable size in the former, then the throwing on or off of these large units may considerably affect the lights, but if the proportion be small and contain no large units, then such effect will probably be small, if not negligible. It therefore depends entirely on the proportion between the two classes of load as to whether they may reasonably be run off the same mains and feeders, or whether it will be more advisable to supply them separately.

Another form of day load which can only be availed of in d. c. plants is the storage battery. The main advantage attained in this case is not so much the working up of a day motor load to increase earnings, as the working during a longer period, of a smaller amount of machinery at lower first cost, and higher working economy. It is a matter of common knowledge that the maximum demand on a lighting plant—the "peak"—is very greatly in excess of the average load, and only for a very short time, and that similarly the minimum demand is considerably lower than the average, but lasts for some time. The plant has to have the capacity of the highest demand, and will therefore be operating at full economy for only a very short time during each 24 hours; and as the lowest demand is probably not much over one-quarter of the greatest, and continues for several hours in the early morning, the result is not only that a large amount of capital is lying idle for probably 20 hours out of each 24, but that

such capital as is being rendered productive is employed at a very low economy. Storage batteries, while being available for supplying motor load, serve another purpose altogether, and a very useful one. The "peak" of the load may be taken by a battery, which can be charged by the generating plant during the long hours of light load. So the generating plant may be designed considerably smaller than the maximum demand, and can be run for a longer time at nearly full efficiency continuously.

In a d.c. plant, where the waterworks are operated in connection with the electric station as above, careful design in many cases may allow of such a proportion of generating and battery plant as that the former may require to run 20 hours each day at not less than three-quarter load. It will be evident that a very great economy will result, both in first cost and in operation, from such a design.

There is some little future before another method of supplying a day load with no increase of plant, but industrial conditions will have to be considerably modified before it becomes very general. If motor load and lighting load were consecutive always, and never concurrent, as they are during winter months, then it is evident that no overlapping would occur, and one set of generating machinery would be sufficient for both, and could run almost continuously; but while such overlapping is possible, it is necessary to provide generating plant for the sum of the two loads, although this sum occurs only for a couple of hours each day, during three or four winter months. If, during winter, the motor load could be supplied only during daylight hours—from say 9 a.m. to 4 p.m.—then the two loads would not interfere, and no increase of capital would be necessary. In many medium-sized plants, specially favorable terms are offered to manufacturers who will agree to do all their power work between these hours, and other business is refused. In such a case it would probably pay to run a special feeder and main circuit for power supply only, using the same electrical and steam plant to furnish current for power during day as runs the lights afterwards.

It is certainly not every case that presents a favorable field for day load, but the chances are that it would be possible and remunerative more often than is generally considered, and the above suggestions may be of use to some as indicating the direction in which to canvas.

ELECTRIC HEATING AND ITS APPLICATIONS.*

By M. FERNAND LE ROY, C.E.

In pursuing his researches Mon. Le Roy sought to attain the following results:

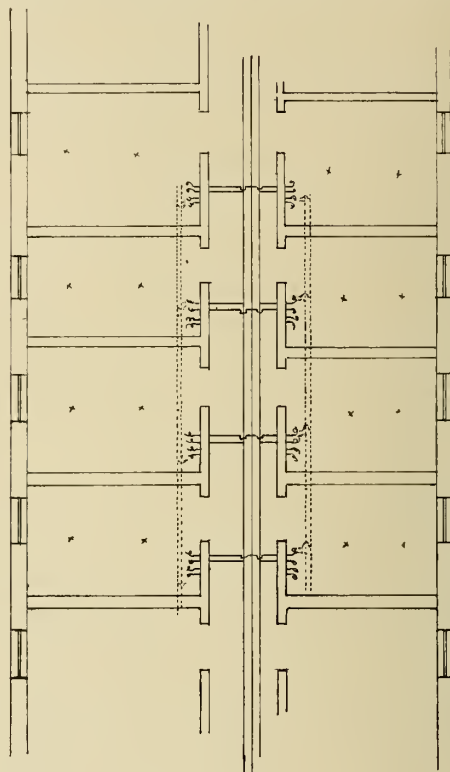
The construction of apparatus of such simple and handy form that the ordinary domestic would experience no difficulty in using it; to make the application readily available in conjunction with the present forms of saucepans, kettles, stoves, irons, etc., so that any change of method on the part of housekeepers would be avoided.

The system is described as consisting essentially in what is called la Buche électrique, or the electric log. A stick of silicium agglomerate metallised at each extremity in order to prevent the overheating of the joints and to insure good contact at the sockets

serviceable, and for general purposes in the kitchen this simple appliance is equally adaptable, as it can be utilized in connection with our present utensils. Hitherto electric cooking devices have been constructed on a much more elaborate and consequently expensive principle, but the method here described bids fair to revolutionize this branch of electrical industry.

WIRING OFFICE BUILDINGS.

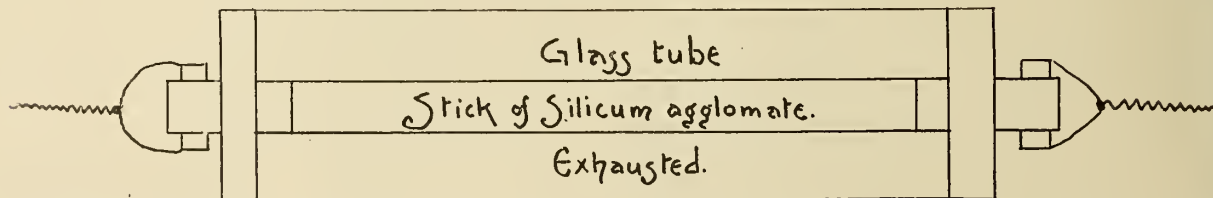
MUCH difficulty is encountered in wiring office buildings on account of the necessity of having to alter offices, and the consequent changes to the wiring for electric light meters. The accompanying sketch illustrates to a certain extent a method adopted by Mr. H. F. Strickland, and which has been put into



METHOD OF WIRING AN OFFICE BUILDING.

practical use. By it a building can be so wired that a suite of offices can be interchanged from one meter to separate meters, or vice versa. The sketch shows a section of an office building with a three-wire service in the corridor, with taps for each office. The four wires extending out of wall are two from service and two from outlets. The dotted lines might be termed a loop circuit, and by this circuit the current can be either connected direct to each office through a separate meter or carried through one meter to all the offices, and the meter can be placed in either office. An additional cost of running two wires through the offices, with a tap coming out beside each meter outlet, will save considerable

BÛCHE ÉLECTRIQUE Actual Size.— Plan.



is inserted in a glass tube, from which, to prevent the oxidation of the silicium, the air is exhausted. The two extremities of the glass tube are set in plaster and the metal ends of the stick are attached to the contact pieces in the same manner as in the case of incandescent lamps (see diagram).

Metal spring clips render the insertion of the heater in the circuit an extremely simple operation.

Each buche or heater is constructed of such dimensions and resistance that the power absorbed under a pressure of 50 volts is from 60 to 100 watts, but of course they can be used under any voltage by arranging them in multiple series.

For warming rooms the apparatus would be particularly

expensive in the future. Mr. Strickland, the electrical contractor, 77 Adelaide street east, Toronto, who is the originator of this method, will be pleased to explain the idea to architects and others who may desire to obtain further information.

A very good rule for the power that a belt will transmit is as follows: Multiply the number of square inches in contact with the smallest pulley by the speed in feet per minute and divide by 36,000. The result will be the horse power that may be transmitted, by a double belt, under the most favorable conditions. Deductions must be made according to the judgment of the engineer, for with a single belt under poor conditions but one-half of the above will be realized in practice.

* Summary of paper communicated to the Society of Civil Engineers, Paris, Feb. 4, 1898.

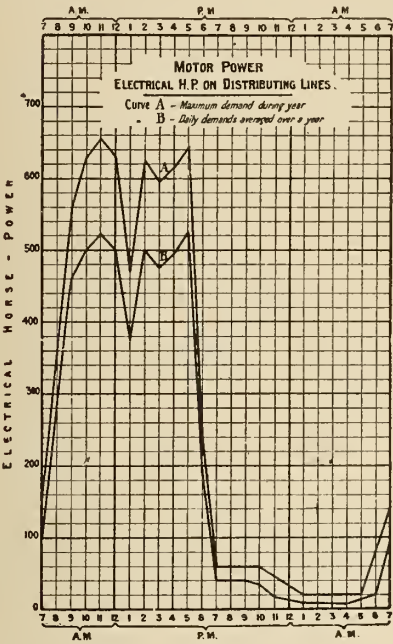
ELECTRICAL POWER TRANSMISSIONS.*

By R. A. Ross, E.E., M.Can.Soc.C.E.
(Continued from June issue.)

The table below illustrates the ratio of plant installed to the output column, one giving the average output per hour figured from the curves for a year, and column two the plant installed to meet maximum demands, while the third shows the ratio between them.

	Incan- descent.	Arc.	Motor Power.	Street Ry.	Total.
Average E.H.P. per hour.....	604	650	218	2,430	3,902
Max. E.H.P. required	2,925	1,300	656	6,450	11,331
Ratio output to capacity	20.6%	50%	33.3%	37.7%	34.4%

It will be seen that the output is only about one-third of that possible with the plant which must be installed. To dispose of



the remaining two-thirds is the ambition of every station manager.

It is just here that the storage battery finds its best field in steam station, but in water power plants it has no place unless the plant be loaded to its full capacity, and an increase is desired which the water available will not admit of.

As an illustration of what is to be expected, the above case is useful, but so simple a case seldom occurs in practice, as instead of having the curves of actual demand, the engineer usually has to draw upon his educated imagination for these, guided by his experience with similar plants.

Having determined the amount of power required for the various demands, and fixed upon the best method of distribution to meet those demands, the problem of the transmission may be taken up intelligently point by point.

GENERAL SYSTEM.

Considering the direct current as out of the question for large transmission purposes, three different alternating systems present themselves, namely, single, two and three phase. The first we are thoroughly familiar with, owing to its use in the purely lighting stations, where it is entirely satisfactory, but when it is necessary to distribute power for motor purposes, it fails, owing to the fact chiefly that single phase motors, while practicable, are not found suitable in operation, as they are not readily started from rest.

The question therefore hinges upon the point of relative superiority of the two and three phase systems.

So far as apparatus is concerned, these two systems are about on a par for all practical purposes when designed for the same conditions of operation, but for the line the three phase has the best of the argument, the transmission copper being reduced 25 p.c. This point of superiority, however, loses much of its effect, for it is possible to use two phase apparatus at both ends of the line, and by means of suitable transformers change from two to three phase for the transmission, in which case the capacity of the transformers used must be slightly increased, as some of the copper is partially inactive when coupled up for change of phase.

For this reason the three phase will be adopted in the case

under consideration, as being probably the cheaper in first cost and equal in efficiency.

VOLTAGE OF TRANSMISSION.

As the copper in the circuit varies inversely as the square of the voltage for the same loss and distance, the advantage of high voltage becomes apparent. Conversely with the same distance and copper, the loss in line may be reduced in proportion to the square of the proportionate increase, or the distance may be increased directly as the increase, and any combination of these may be attained by simply raising the voltage.

On the other hand, the apparatus installed must be designed to resist the effects of the increase on the insulation, and greater precautions are necessary to maintain it in operative condition. The cost will also be somewhat greater where especially high voltages are used.

The highest voltage in practical operation at the present time, so far as I am aware, is at Ogden, Utah, where 16,000 is used with raising transformers.

The highest generated directly on a machine without the aid of transformers is 12,000, at the Chambly plant. There are several now building, however, which contemplate a line voltage of 20,000, and we may expect to see this figure increased from time to time as methods of insulation improve.

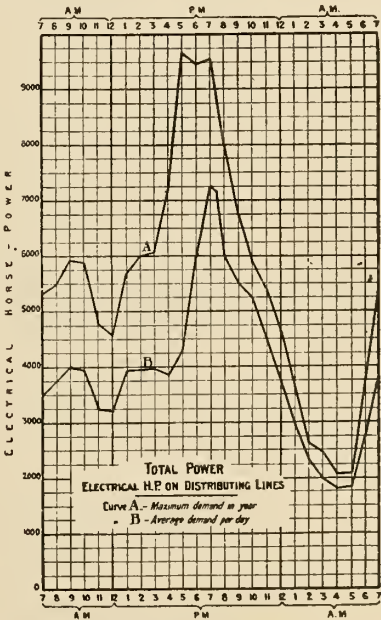
It is well to remember that the apparatus will be called upon to resist much more than the normal pressure, owing to conditions of load to opening of circuits under load, and to lightning, so that a large factor of safety is essential where high voltage is desired.

PERIODICITY.

In former years a high periodicity of 120 to 133 per second was general, being suitable for lighting purposes, and by reason of the high period, transformer costs were low. With the advent of the alternating motor and of long transmission lines, the periodicity dropped to 60, which is now the standard in America. In Europe, however, the tendency is to go even lower, and each maker of apparatus appears to have his own standard.

The lowest possible where incandescent lighting is to be done is 25, for at this alternation the fluctuations are just visible in the light.

The effects of lowering the periodicity are to decrease induction



effects (which are always objectionable), simplify and cheapen the motor equipment and to increase somewhat the cost of transformers.

It would appear that for general transmission work, which involves the use of much power for motors, a lower alternation would have met the case speeds better, but as 60 periods has been universally adopted on this continent, it will probably be maintained for some time.

REGULATION.

Owing to the copper losses and induction effects at various loads on the system from the generator shaft to the lamps or motors, the generator voltage must be raised as the load increases. It is very desirable that this increase be kept as low as possible, so that a continual adjustment of the voltage be not necessary, rendering the lights unsteady.

To this end the copper losses, and especially the induction

effects, must be kept within bounds. The first involves only the cost of the copper, the latter depends upon the nature of the demands and the relative positions of the copper conductors. The induction of lines and apparatus has an effect somewhat similar to that of the inertia of water in long pipes, and causes the current to lag behind the voltage, necessitating a large output of volt-amperes to produce watts, and, as lines and apparatus must be of sufficient capacity to carry the useless increase of current and the generator to allow for the useless additional volts, an increased capacity of plant is necessary.

These induction effects may have a larger influence on the regulation than the necessary copper losses, and should be carefully watched.

It is well to bear in mind, however, that the increased volt-ampere readings do not represent additional power consumption, as would be the case in direct current, as they have to be multiplied by the cosine of the angle of lag (which is always less than unity) to give the true power.

Poor regulation therefore cuts down the capacity of the plant, and renders it difficult to maintain the voltage constant under varying loads.

Having thus sketched the main points which affect the general working of the plants, the apparatus may be taken up in detail.

DISTRIBUTING STATION.

The reducing transformers necessary for lowering the line voltage to that suitable for the incandescent distribution, arc light motors, and rotary transformers for railway service, must be of the highest grade to stand the high line potential, as well as the increases of voltage to which they may be subjected under certain conditions. Of course the efficiency should be of the highest and the regulation good. As the heat developed is great, an air blast or circulation of cool oil is provided.

The rotary transformers which form such a large part of the load in this case partake both of the nature of alternating motors and of direct current generators. As an alternating current motor of synchronous type they must be self-starting, and in consequence are of either two or three phase.

As a generator they must, at the speed established by the synchronous motor part, give the necessary direct current at the proper voltage for the trolley line, as both the motor action and the voltage generation take place in the one set of armature windings, and as the fields are common to both there is a certain ratio of impressed alternating voltage to direct voltage at the commutator, which is constant, and any change of field strength alters the direct current voltage only indirectly by causing a leading or lagging current in the transmission lines, thus giving more or less volts to the alternating side of the machine.

Owing to this effect of over or under excitation of the rotary upon the line currents, causing them to lead or lag behind the voltage, this apparatus may be arranged to keep the current and voltage of the line in phase, thus doing away with the troubles from lagging currents which so unfavorably affect the system in the matter of regulation. On the other hand, where there is no necessity for close regulation, the line induction is encouraged, and is found useful in overcompounding the direct current side of the rotary automatically, thus giving the rise of voltage with load, so desirable in railway work.

In the present case, if the lighting and railway loads be carried upon separate lines, the latter arrangement is desirable, as the lighting will have good regulation while the railway service will overcompound automatically.

The total load for railway needs being 6,450 E.H.P., and the average from 7 a.m. to 9 p. m. being 3,000 E. H. P., seven units of 1,000 E.H.P. should cover the demands, and the machines in operation should have a good load factor.

For the arc light demands as before stated, eight units would be sufficient. The motors may be either synchronous or induction, the former preferably, as they may be useful in assisting the regulation of the incandescent lighting service by proper excitation, as their loads do not fluctuate.

This apparatus, with the necessary switchboard and instruments for the high potential receiving and lower potential distributing circuits, completes the distributing station equipment.

TRANSMISSION LINE.

The line is usually the weakest link in the chain, being exposed to the weather, and not under that careful supervision which is given to the rest of the plant.

The pole line as a supporting structure must of course be of the solidest to stand the strains imposed, not only by the weight of

copper, but in these latitudes by a great weight of ice also, which, if assisted by a gale, will try the best work to the utmost.

Poles of cedar, pine or chestnut of very heavy section are necessary for this work. They should be set in concrete or broken stone and heavily guyed on curves, or in certain positions double poles with heavy cross-arms between should be used.

The insulators for high potential work are universally made of porcelain, as that material weathers better than glass and is not so hygroscopic.

This porcelain should be so thoroughly vitrified as to exhibit a fracture like glass when broken, otherwise it will absorb moisture and break down.

To minimize surface leakage, which, if severe, may burn off the pins, the surface over which it has to take place is made as long and of as small surface as possible. To assist in reducing this leakage, insulators with oil in grooves, over the surface of which the leakage must take place, have been tried and found to work well when the oil surface is clean, but in operation dirt accumulates and troubles ensue, so that the plain porcelain insulator of large insulating surface and high resistance to piercing is now the standard.

The copper circuits are of bare copper, as weather-proof insulation at high voltages is perfectly useless, the cross-section of the copper being of course so proportioned as to give the loss determined upon as suitable for the conditions existing. These conditions depend upon the cost of the power, the amount available and the demands. The loss may be reduced to any extent by the use of more copper, but unless there is a demand for the power saved, which will pay interest and depreciation on the additional cost of circuits, no economy results.

On the other hand, the copper may be reduced and the losses increased, but only within the bounds set by the demands of good regulation.

In practice a loss of 15 per cent. is seldom exceeded, and a very common allowance is from 7 per cent. to 10 per cent.

Several effects manifest themselves in alternating lines which do not exist on those of direct current systems, and they deserve the closest attention in planning the system. While the actual losses in direct and alternating work are about the same under the same conditions, the drop in voltage in the former is a measure of that loss, while in the latter it may be no indication.

In fact, it is possible to so arrange the circuits in some cases of alternating work as to have a greater voltage at the end of the circuit than is generated at the station, but this does not indicate that the line generates power of itself; it simply means that, while the self-induction and capacity of the line and load raises the voltage, much as a water ram in a pipe line raises the pressure, it at the same time throws the current out of phase with that voltage, and the real power is that obtained by the multiplication of the apparent volt-amperes by the cosine of the angle of lag introduced. It is therefore only possible to read the power indications on a watt-meter, which instrument takes account of this angle, while the volt and ampere meter readings which are used to determine direct current power are not reliable for the alternating.

This increase of voltage may under certain conditions become so serious as to endanger the insulation of line and apparatus.

In most cases it is advisable to reduce the induction as much as possible, and to effect this the wires on opposite sides of the circuit are strung as closely together as is consistent with safety, and several wires of equivalent cross section used rather than a smaller number of larger area.

To do away with unbalancing of the phases of the system, the circuits should be strung symmetrically, which is affected in the case of two phase lines by placing the going and returning wires of each phase on the opposite ends of the diagonal of a square, and in three-phase lines by stringing the three conductors at the corners of an equilateral triangle.

As lightning may cause trouble, not only by direct stroke, but by the accumulation of static electricity upon the lines, means must be provided for getting rid of it safely. To this end, guard lines of barbed wire are strung above the circuits, and these are grounded at frequent intervals.

GENERATING PLANT.

The apparatus in this part of the plant consists of the water-wheels, generator, raising transformers and switchboard apparatus.

Regarding the latter two, the same remarks apply as were made regarding similar apparatus in the distributing station.

As to the generators, their size is usually limited by the power

of the water-wheel units, and their speed by the wheel speed, unless gearing be used.

The usual method of attacking the question with direct-connected units is to arrange for as powerful wheels as is possible consistent with having the proper size units to handle the load properly, and designing the generators to suit the wheels as regards size and speed.

Vertical turbines with the rotating part of the generator revolving in a horizontal plane are usual, but, in several recent plants, horizontal turbines are used direct connected to the generators, which in that case are below the crest of the dam and above the tail-race by an amount determined by the height of the draft tube. The first system introduces footstep bearings, which are always more or less objectionable, but removes the delicate armature windings from chance of damage by water. The second places the generator at the mercy of water-tight bulkheads and stuffing-boxes.

As to the voltage to be generated upon the machines, if raising transformers are used, this is of little consequence unless from a machine designer's point of view, as the transformers will have equal efficiency at any ratio of transformation.

Where the transmission voltage is not dangerously high, it is of course preferable to do away with these transformers, and generate directly on the machine.

In deciding this point it must be kept in mind that the failure of a transformer through the breaking down of insulation is a much less serious matter than that of a generator, which is less likely to occur when that apparatus is of low voltage. Owing, however, to improved types of generators, we may expect to see raising transformers dispensed with in many cases where they would have been deemed indispensable with older types.

In specifications drawn up for the generating apparatus, the following points are strongly insisted upon :

- (1) That the heating of any part shall not exceed a certain specified temperature after a certain length of run at full load and an additional time at a certain specified overload.
- (2) That the efficiency at full load, three quarters, one half, and one quarter loads, shall be guaranteed by the tenderer and proved by test.
- (3) That the regulation of the generator shall be within a certain per cent. at full non-inductive load.
- (4) That the insulation of any part of the machine shall not break down under a specified voltage which is high enough to allow of a good factor of safety over the normal pressure.

Although it is impossible to specify limits for these requirements which will suit every case, it may be said generally that the allowable increase of temperatures for large generators ranges from thirty to forty degrees centigrade. The full load efficiency from ninety-four to ninety-six per cent. The regulation depends upon whether the machine is compound wound or not. In the former case the regulation may be anything for which the compounding is set, and in the latter from three to ten per cent.

The test voltage applied ranges from three to ten times the operative, the former factor for high voltage machines, the latter for low voltages.

The modern generator being either of the inductor or revolving field type, in which the high potential armature windings are stationary, lends itself to high voltage generation, as the insulation spaces may be increased largely without rendering the machines unwieldy, for the reason that the armature wires are distributed over the outside ring where space is more abundant, and the vibration of running, which abrades, and finally breaks down the insulation on the older revolving armature types, is largely absent in the newer machines.

Having sketched in a general way the points to be considered, and determined upon the general features of the transmission, we may take up the figuring of lines, efficiencies and horse-powers to be generated.

To do this, certain assumptions must be made as to the allowable efficiencies of the line and apparatus at various loads, which has been done in the tables below. As regards the apparatus, commercial efficiencies have been assumed which are usual for this class of work, and will be guaranteed by the manufacturers. The line efficiencies are what would be usually allowed, considering the copper as designed for those efficiencies at maximum demand.

TRANSMISSION (generator to sub-station)	Loads.			
	100%	75%	50%	25%
Generators.....	96	95	94	90
Line.....	90	92.5	95	97.7
Raising and lowering transformers.....	96	95	94	90
Total efficiency of transmission....	83	83	84	79

INCANDESCENT (distribution to lamps).		Loads.			
Primary distribution at 2,000 volts.....	96	97	98	99	
Large reducing transformers.....	97	97.5	97	95	
Secondary distribution to lamps.....	97	98	98.5	99	
Total efficiency of distribution.....	91	92.5	93.5	93	
ARC LIGHTING (distribution to lamps).					
Efficiency of motor.....	92				
Efficiency of arc machine.....	86				
Efficiency of line distribution to lamps..	93				
Total efficiency of distribution.....	72.6				
POWER CIRCUIT (distribution to motors).					
Efficiency of lines.....	90	92.5	95	97.5	
Efficiency of transformers.....	96	95	94	92	
Total efficiency of distribution.....	86.4	88	87	89.7	
RAILWAY POWER (distribution to motors).					
Efficiency of rotary transformers..	96	96	95	90	
Efficiency of distributing lines to motors	80	85	90	95	
Total efficiency of distribution.....	76.8	81.6	85.5	85.5	

From these efficiencies of line and apparatus the whole power necessary for all the maximum demands may be transmitted at an efficiency of 80 p. c. from the generator shaft to the distributing lines in the city.

The total efficiency at full load from the generator shaft to the lamps, railway and stationary motors, is 68 p. c., and under the average running conditions would be not less than 70 p. c.

These figures illustrate the remarkable efficiency of electrical transmission even on such a mixed and varying load. It will be noticed that at varying loads the efficiencies are not very different, owing to the fact that, while the apparatus falls off, the line increases in efficiency, thus maintaining a balance.

In fact, under light loads the efficiency is higher than under heavy, and is actually higher than given in the totals, because the tables consider the whole plant as operating at fractional load, while in actual running the apparatus would be kept at full load by shutting down units as the load dropped, thus raising the efficiency. The figure of 68 p. c. therefore may be safely taken as the lowest to be met with during the course of the year, and as it holds only for the peak of the load will not affect the average efficiency materially.

The date assumed or calculated for the transmission is given below.

The power is that necessary at the distributing lines to take care of the maximum demands as shown on the curve of total power. The power factor is assumed to be 100 p. c. for the class of load considered, loss in transformers 4 p. c., in line 10 p. c., which is not too high for the peak of the load, as this is what the line is designed for.

Electrical H. P. required at end of transmission line.....	11,946
Voltage of transmission at end of transmission line....	15,000
Periodicity or complete cycles per second.....	60
Distance transmitted in miles.....	10
Power factor assumed p. c.....	100
Loss in transformers p. c.....	4
Loss in line p. c.....	10
System of transmission—three phase.....	

Figuring the transmission on the above assumptions the actual electrical horse power at the generator terminals is 13,623, while the apparent horse power as read by volts and amperes is 13,862. In other words, while the real loss in the transmission is 14 p. c. of the power required at the end of the line, the apparent loss is 16 p. c. This shows a high power factor for the whole system, and is obtained by a non-inductive load on a line well subdivided, and with the wires properly placed.

To illustrate the effect of an inductive load upon the amount of apparatus necessary, another line with a load power factor of 90 p. c. has been figured, the other conditions remaining the same as before. This, while having the same losses as in the first case, requires 17,327 apparent horse power at the generator, necessitating an increase of generating apparatus of 25 p. c., or, in case the plant were installed, it would cut down its capacity 20 p. c., and would decrease that of the distributing apparatus 10 p. c.

Were it not for these induction effects the problem would be as simple as in the case of direct current work, but as it is, they affect the matter to a very great degree, and require the most careful consideration to arrive at even a fair approximation to actual results.

Considering the fact that this power is laid down from the wheels with such simple machinery with but at most one revolving part, and therefore requiring no attention when once started, it is not surprising that electricity should have monopolized the field. The efforts at the present time to transmit to longer distances

will be successful in proportion as the knowledge of insulating methods increase; and, from the rapidity with which the present voltages have been attained from the lower formerly prevailing, it is not difficult to foresee the time when this country, which is so rich in water power, will be literally covered with power lines for all purposes. The possibilities in the way of covering an increased territory by raising the voltage may be illustrated by the plant considered above, where, with 15,000 volts and 14 p. c. loss, the power covers a radius of ten miles in all directions. If the voltage were doubled, and the same loss allowed, the radius would be 40 miles, and the territory covered would be sixteen times as great. In other words, the area served will vary as the fourth power of the ratio of increase of voltage. The question of the advisability of transmitting from a distance the natural power available in preference to generation at the centre of distribution by steam power, requires the most careful attention. The cost of the power laid down on the consumer's premises is made up of two items, namely, fixed charges and operating expenses. The first includes interest and depreciation on the plant, the second coal and supplies, attendance, etc. The saving by the adoption of water power is in coal and supplies, and perhaps a small part of the labor, provided the plant cost is the same. Should, however, the cost of the transmission scheme be enough larger than that of the steam to eat up the saving in interest and depreciation on the increased cost of plant, there is nothing to be said in favor of the transmission.

If there is no cheapening of cost the steam plant has the advantage of the greater reliability in lines and apparatus, as no high voltages need be used, and there is no risk of troubles with water power during the winter such as exist to a greater or less extent in this climate.

In many cases, however, where the water power improvement can be made with small outlay per horse power rendered available, the gain may be large. It is not so large, however, as seems to be the idea of the public, which considers a water power as capable of producing power for nothing, entirely ignoring the capitalization necessary for development.

The transmission and utilization of electric power has got beyond the experimental stage, and is not now surrounded with that mystery which used to obscure the financial facts, and the more it is considered as a commercial article depending upon the laws of supply and demand for its existence, the more will its usefulness become apparent to the consumer and its financial security appeal to the capitalist.

SELECTION, HANDLING AND CARE OF BELTS.

NEARLY every engineer has one or more belts under his care, and from the condition many of them are in it would seem that a word of advice as to their selection and care would not be amiss, writes Charles H. Garlick, in *Lumber*.

If, when in need of a belt, the engineer would, instead of simply ordering a certain number of feet of a certain width and thickness, try the experiment of personally selecting the same for the work which he wishes to have the belt do, and then use the same care in placing the belt in use that he does in starting any other piece of new work or new machine, much better results would be obtained than is usually the case. There are many, very many, rules and formulæ for ascertaining the width of belt necessary for transmitting a certain amount of power. No two of these rules agree, because there are so many conditions that enter into the problem that no hard and fast rule can be used.

From the writer's experience he prefers to use the following formula, which in ordinary cases will be found nearly correct:

$$W = \frac{H.P. \times 5,500}{\text{Velocity} \times \text{contact in feet.}}$$

This is single thickness. For double thickness belts:

$$W = \frac{H.P. \times 3,600}{\text{Velocity} \times \text{contact in feet.}}$$

Or the width of the belt can be found by multiplying horse power to be transmitted by 3,600, and dividing

the product by the number of feet of the belt that will pass over the pulley per minute, multiplied by the number of feet of belt in contact with the driving pulley. A very good "rule of thumb" for single belts is: Belting 1 inch wide having a velocity of 600 feet per minute, will transmit 1 horse-power.

It should be borne in mind, however, that the width of the belt necessary to transmit a certain horse power depends on several conditions, one of which is the tension of the belt. When a belt is too tight there is a constant waste in journal friction, and when too loose a great loss in efficiency from "slip." A belt should be procured that will deliver the power required in a fairly slack condition.

Between a slow speed and a wide belt and high speed and a narrow belt, choose high speed and narrow belt wherever practicable, in designing for the transmission of power. A velocity of belt up to a mile a minute is practicable and advantageous.

In taking lengths for belts, where it is not convenient to measure with a tape-line the length required, this rule will be found of service: Add the diameters of the two pulleys together, divide the result by 2, and multiply the quotient by $3\frac{1}{4}$; add the product to twice the distance between the centres of shafting, and you have the length required, very nearly.

In buying, be sure that the leather is oak tanned, has a smooth, polished surface and a fine fiber. It is a good idea to have the belt unrolled and examine it to see that laps are thoroughly made and fastened. Note whether the belt is of the same uniform thickness throughout its entire length, also that the belt is pliable and not harsh and brittle. Note if possible whether the hides which make up the belts are of uniform thickness, or whether the thickness of belt is obtained by splitting the hides, and if the latter is the case reject it.

As to whether you purchase single or double belts, it may be said that single belts can be used successfully up to twelve or fourteen inches in width, but where more power is required than a belt of this width will transmit under the conditions that exist in your plant, belts of double thickness should be used. With single belts, care should be taken to have them of ample width, so that there need be no necessity of having them tight. Double belts should be used when a great strain is to be put on the leather, or for slow speed, or when a belt is to be run at one-fourth turn; belts which you are called upon to shift frequently, or which are to run on vertical shafts, should be double.

As to the respective value of rubber or leather belts: Rubber belts do not cost as much as leather, nor do they, under favorable conditions, last as long. They cannot be used in places where the belt rubs, nor where it becomes necessary to shift often; neither can they, as a rule, be run successfully as cross belts. They should not be used where oil is likely to drop on them, nor where they will freeze. They usually last longer than leather belts in damp localities. Rubber belts will adhere to pulleys better than leather. When a rubber belt commences to wear out it is almost impossible to do anything to repair it. Having purchased a new leather belt, it should, if time will permit, be stretched before being placed in work. This can be done in a variety of ways, depending on the width and length of belt and the time at the engineer's disposal. One way is to stretch it over two pulleys placed some distance apart, and attach weights to either end of the belt. During

the stretching period a little oil should be applied to the leather.

Belting for electric lighting machinery must have some characteristics all its own. For ordinary machines a positive steady motion is not absolutely necessary, but with an electric plant it is different. It is necessary for the belt to be endless and of a uniform thickness. Even so small a thing as uneven laps will cause a slight but constant jumping or flickering of lamps. With most dynamos as built to-day provision is made for the purpose of taking up any stretch that may occur in a properly-constructed, designed and well-stretched belt. Yet, should it become necessary to shorten one of these belts, it may be done by using clamps. Care should be taken and the laps made as long as possible, and sufficient time given the work before removing the clamps.

While endless belts are to be preferred for almost all work, yet in many places the time, care and experience required to join them is such that recourse is had to the

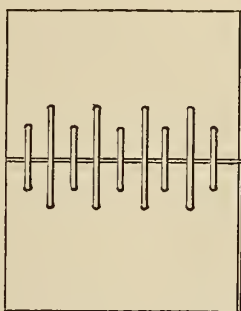


FIG. 1—Side of lacing running next to pulley.

more convenient method of lacing or fastening with clamps or hooks, and of all the different methods the writer has been more successful with and prefers lacing. But even such a simple piece of work as that of joining a belt by means of lace—a narrow strip of rawhide—is sometimes done in a manner to very materially reduce the life of the belt, and very seldom is sufficient time or care given to this work. The ends of the belts should be cut exactly square, using an ordinary tri-square for this purpose. Punch the holes exactly opposite each other in the two ends of the belt to be joined. It is best to use an oval punch for this purpose, the longest diameter of holes being parallel with the belt. Two rows of holes should be made in each end of the belt,

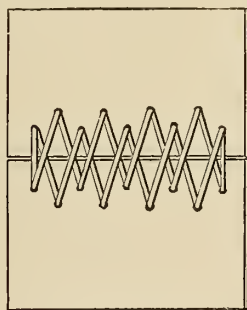


FIG. 2—Outside of lacing.

the same being staggered. The edges of holes should all be at least seven-eighths of an inch from the end or side of belt; be sure and keep the belt square, and lace both ends equally tight. The laces should not be crossed on the side that runs next to the pulley, but on that side laces should run parallel with the belt. Fig. 1 shows the inside of the lacing, or the side that should run next to the pulleys, and Fig. 2 shows the outside of the lacing, the side that is not in contact with the pulley.

In placing the belt on pulley, put it on so that pulley in slipping will run with, and not against, splice or joint.

While authorities differ as to which side of the belt should be placed next to the pulley, the writer's experience has been that the best results are obtained when the grain side is placed next to the pulley. Experience has proven that it will drive more than when the flesh side is in contact with the pulley, and that the belt will last longer.

If the belt is to be crossed, do not put it on in such a manner that at the places of passing joints or laps will meet and be turned up and ruined in a short time.

How to place a belt on a pulley is one of the little things one can become an adept in only by practice. If the belt is a heavy one and the pulley runs at a high speed, it is best to slow down the machine, then place the belt on the loose pulley or the pulley at rest. Secure a firm footing, and with the right hand slowly work the belt up to top of pulley, when a quick jerk down or up, according to the direction the pulley is running, will throw the belt on. When the belt is heavy, or the operator lacks experience, it is best to shut off the power, place the belt on pulley as far as possible, then take a small leather belt, or even a rope, double it, slip one end through the arms of the pulley and around the belt and rim of the pulley, and the other end through the loop formed by the double of the small belt or rope; then stand on the floor on the opposite side and draw on the small belt or rope, when the belt will be drawn to the rim of the pulley. When the machine is placed in motion, the belt may be slipped on without any trouble; then, by letting go of the small belt or rope when the belt is on the pulley, the noose will be undone and the small belt will be free.

If the belt does not stay on the pulley, do not erect guards to keep it on, as they are an eyesore, and soon wear the belt out. Besides, the guards simply cure an effect, while the cause remains. The cause may be that the pulley is not in line, or that the belt is not joined squarely, or one side is stretched more than the other. Sometimes a belt running at high speed, transmitting scarcely any power, will wave from one side of the pulley to the other, and if a load is not thrown off will eventually come off. In places where it was not convenient to either put in pulleys of larger diameter, or even wider belts, and where the use of resin, oil and other adhesive matter would not cause the belt to adhere to the pulley, the difficulty has been overcome by running a narrow belt, drawn tightly, with ends laced, over the main belt. In one place where occurred a continual slipping of a ten-inch belt, the writer took an old two-inch belt, placed it upon the ten-inch, and the two belts carried the load for years without trouble.

According to Electrical Engineering, of Chicago, the total number of telephones in use in various countries has been tabulated as follows: Province of Angola, 200; Austria, 20,000; Australia, 2,000; Bavaria, 15,000; Belgium, 11,000; British India, 2,000; Bulgaria, 300; Cape of Good Hope, 600; Cochin, China, 200; Cuba, 2,500; Denmark, 15,000; Finland, 6,000; France, 35,000; Germany, 140,000; Great Britain, 75,000; Holland, 12,000; Hungary, 10,000; Italy, 14,000; Japan, 3,500; Luxemburg, 2,000; Norway, 16,000; Portugal, 2,000; Roumania, 400; Russia, 18,000; Senegal, 400; Spain, 12,000; Sweden, 50,000; Switzerland, 30,000; Tunis, 300; United States, 900,000; Wurtemberg, 7,000. These give a total of 1,402,100.

SPARKS.

H. C. Baird & Son will probably put in an incandescent light plant at Parkhill, Ont.

The Halifax Electric Tramway Company has declared an annual dividend of six per cent.

A movement is on foot at Ottawa to secure a popular vote on the question of operating the street railway on Sundays.

The sum of \$20,000 is to be expended for the continuation of the telegraphic service on the north shore of the St. Lawrence.

The C.P.R. are equipping new telegraph offices in Winnipeg, under the superintendence of Mr. W. J. Camp, the company's electrician.

The Royal Electric Co. has installed a 15 h.p. Stanley induction motor for the Montreal Water & Power Co., which is to be used for pumping purposes.

The Common Council of St. John, N. B., has authorized the Safety Board to make arrangements for lighting the city at the expiration of the present contract.

The Royal Electric Co. has secured an order from the corporation of Joliette for a 120 k.w. S.K.C. generator, with full complement of transformers, etc.

The city engineer of Toronto is preparing specifications for an electric plant to be placed in the new municipal buildings, and at an early date tenders for same will be invited.

The Montmorency Power Co., of Quebec, has made an addition to their plant by the installation of another 600 k.w. S.K.C. generator, which was purchased from the Royal Electric Company.

The Napanee Water & Electric Light Co. have gone into the incandescent lighting business, and are now serving lights from their new S.K.C. plant recently installed by the Royal Electric Co.

The Niagara Falls Park and River Railway Company have completed the work of laying their tracks on the new steel arch bridge at Niagara Falls, and the first car was run over it on July 1st.

The Galt and Preston Electric Railway Company have asked the towns of Berlin and Waterloo for a bonus of \$40,000, in consideration of connection by their railway with the C.P.R. The by-law to grant \$12,000 has been carried by the town of Waterloo.

Messrs. Miller Bros. & Toms, of Montreal, have placed an order with the Royal Electric Company for two 40 h.p. direct current motors. The machines will be direct connected to two Quimby screw pumps, and will be used for the operation of elevators, etc.

A number of Montreal gentlemen have purchased a mountain at St. Bruno, Chambly district, about ten miles from Montreal, and purpose expending a large sum of money in improvements. An electric railway from Montreal to St. Bruno is included in the scheme.

The Sherbrooke Gas & Water Co. has closed a contract with the Royal Electric Co. for two 240 k.w. S.K.C. generators. This is the fifth order that has been placed with the Royal Electric Co. for S.K.C. machinery by the Sherbrooke Water & Gas Co. within the last two years.

It has been decided not to extend the electric railway system of Quebec to Montmorency this year, but everything will be got in readiness during the winter to change the motive power of the entire railway from Quebec to Cap Tourment from steam to electric next spring.

The recently-formed Ottawa Electrical Association have elected the following officers: Hon. president, T. Ahearn; president, J. Murphy; vice-president, B. Marchand; secretary, E. Bailey; treasurer, B. Nolan. Executive Committee: Messrs. W. G. Bradley, E. J. O'Reilly, P. Grimes and J. Johnson.

On Queen's birthday an electric railway car with sixty tired holiday makers on board was proceeding from Vancouver to New Westminster, B.C., at a rapid pace when an axle broke and the car completely overturned. The 60 occupants were jumbled together in one mass as the car still on its side ploughed along the side of the track. Miraculously as it seems, nobody was killed, though several people were more or less injured.

John Philip, of Grand Valley, Ont., has secured a franchise from the corporation of Arthur for the supply of electric light in that town. He will generate the current at Grand Valley from his S.K.C. plant, and with the aid of step-up transformers transmit it to Arthur, a distance of 16 miles. Mr. Philip will illuminate the

streets of Arthur with alternating current arc lamps. The order for the complete work has been placed with the Royal Electric Co.

The adjourned annual meeting of the shareholders of the Hamilton, Chedoke & Ancaster Electric Railway Company was held on June 19th. The reports showed that about \$30,000 of stock had been placed. The company wish to dispose of \$10,000 more before beginning active operations. Following are the new directors and officers: Messrs. E. A. Clifford, president; Jacob Shaver, vice-president; E. Kenrick, auditor; E. Henderson and W. R. Clarke. Mr. W. F. Walker, Q.C., was re-appointed secretary-treasurer and solicitor.

As sources of energy, it has been proposed to use the peat bogs of North Germany, and what is now practically waste land is expected to become available for manufacturing on a large scale. The bogs of the Valley of the Elms, for example, cover some 13,000 square miles, and the proposition has been made to erect in this section a 10,000 horse power electric plant which would consume annually some 200,000 tons of peat, equivalent to the amount yielded by 200 acres. One acre of bog averaging ten feet in thickness contains about 1,000 tons of dried peat, and the amount produced on 430 square miles would afford as much heating power as the 80,000,000 or more tons of coal annually mined in Germany. The proposed plan contemplates using the energy on a canal and in the manufacture of calcium carbide.

At the annual meeting of the Ottawa Electric Light Co., held on June 28th, Mr. T. Ahearn was elected president, Hon. E. H. Bronson vice-president, and Mr. J. W. McRae managing director. The revenue for the year was \$159,583.54 from ordinary sources of light, heat and power, this amount being an increase over previous year of \$5,659.12. The gross expenditure for the year was \$109,117.61, an increase of \$10,293.58. The report recommended that no dividend be paid for the past half year, but that \$12,520 be placed to the credit of rest account, also the whole balance of \$24,368.03 to the credit of the profit and loss account. It may be stated that the company paid four per cent. for the first half year and has been paying eight per cent. annually lately, but the directors conclude that proper allowances have not hitherto been made for depreciation and renewals.

Some particulars have come to hand of the project of harnessing the Rio Cobre, in Jamaica, by the West India Electric Company, of which Mr. Henry Holgate, late of Montreal, is manager. The works are situated near the great tunnel at Boy Walk, at which point the river is 160 feet wide. The dam will stretch from one bank to the other, to be embedded in the solid rock. The concrete and masonry sunk in the rock of the river bottom will go ten feet below the water, and above the water the walls of the dam will rise some nine feet or thereabouts. The water is taken in from the dam by a pipe eight feet in diameter. The pipe will convey about 20,000 cubic feet of water, or about 120,000 gallons, a minute to the power works. The pipe will be provided with a steel valve to regulate and control the supply of water to the power house. The pipe which leads from the dam to the power house will run alongside the river for one mile and a quarter. The power house will be built entirely of steel and concrete, the steel work alone weighing 250,000 pounds. The river in its course for one mile and a quarter drops about 47 feet, which, added to the foot of the dam, amounts to 56 feet, which will be the fall of the pipe in its course to the works.

The Montreal Transportation Company have just completed a new elevator at Kingston, Ont., the power house of which is built of brick, 48 x 52 feet. There is a brick chimney, 136 feet high, with a four foot six inch flue. It stands on a thirteen foot six inch square base, running to the height of twenty feet. It then points into an octagon, and from the height of twenty-five feet from the ground the remainder is circular. The engine in the power house is a Corliss tandem compound, with cylinders twenty inch, forty inch and forty-eight inch stroke. There are also an improved Blake twin vertical air pump and condenser, a 600 horse power heater, supplying water to the boiler heated to 210 degrees Fah.; an outside packed boiler, plunger pump, 8 x 5 x 12 feet, for feeding the boilers, and a battery of three boilers, each 16 x 72 inches. There is also a fire pump with a capacity of 750 gallons per minute. The power house is provided with an electric lighting plant. An 8 x 10 inch Ideal engine is direct connected to a dynamo operating at 110 volts, made by the General Electric Company, of Peterboro'. This dynamo lights over 200 sixteen candle power incandescent lamps in the elevator, power house and office, besides twelve special arc lamps on the wharf, being long burning lamps on the incandescent system.

ELECTRIC RAILWAY DEPARTMENT.

THE HULL ELECTRIC RAILWAY.*

By F. C. ARMSTRONG.

At the present stage of electric railway development, there is no subject more attractive to the electrical engineer, or which more seriously demands the consideration of the steam railroad manager, than the possibility, as yet mainly undefined, of the profitable conversion to electrical operation of existing roads operated by steam. In the street railway field, the success of electric traction has been of the "veni vidi vici" order; the mule, the horse and the cable are in process of becoming memories within the short stretch of less than one decade. A similarly successful attack on the larger field at present occupied by the steam locomotive, is another matter. For one thing, the steam locomotive is admittedly doing its work and doing it well and economically; for another, the transmission factor is at present, working it out in any way we choose, a serious limitation of

tion of this possibility is found in the case of the Hull electric railway.

The Hull electric railway runs from Hull, a city of 15,000 inhabitants, lying immediately across the river from Ottawa, the capital of the Dominion of Canada, to Aylmer, a village of 2,500 inhabitants.

Until June, 1897, the main line was known as the Aylmer branch of the Canadian Pacific Railway, connecting at Hull with the C. P. R. and at Aylmer with the Pontiac & Pacific Junction, a road running north some 70 or 80 miles, through the county of Pontiac. While operated as the Aylmer branch of the C. P. R., its business consisted of transferring passengers and freight from the Pontiac & Pacific Junction road to the Canadian Pacific main line, a considerable freight business in hauling lumber from some large mills, located midway at Deschenes, and also what passenger traffic existed between Aylmer and the city of Ottawa.



HULL ELECTRIC RAILWAY—ELECTRIC FREIGHT AND PASSENGER TRAIN.

range in the substitution of electricity for steam, even in suburban practice.

The work of the past two or three years, however, has established certain important points, even to the mind of the most prejudiced steam railroad manager. The B. & O. installation at Baltimore has demonstrated the possibility of constructing and operating electric locomotives capable of exerting a greater tractive effort than the most powerful steam locomotives anywhere in use. The work on the New York, New Haven & Hartford branches, on the elevated roads in Chicago and elsewhere, and on the important suburban lines which control the local business centering in Cleveland and other cities, has shown clearly the commercial advantages to be gained by the conversion to electricity where quick and frequent service is demanded over distances up to 25 and 30 miles. There is no doubt that even with our present transmission limitations, a very large field exists for the electrical equipment of suburban and branch lines of steam roads, where the present or possible business is of such a nature that its full development can only be attained under the special conditions of operation rendered possible by the use of electric traction. An excellent example of the successful realiza-

Its operation under these conditions was unprofitable, and the Canadian Pacific Railroad was quite willing, when approached by capitalists interested in lumber mills and water power along the line, to lease the property, consisting mainly of 10 miles of single track, for \$5,000 per annum. The equipment of the road, for electric traction, was immediately proceeded with, the power house being located at Deschenes, midway between Hull and Aylmer, where an excellent and cheaply developed water power was available. The gentlemen interested in the property are among the most prominent in financial and business circles in Ottawa, and they have not spared any expenditure necessary to put the road in the best possible shape to handle the business and pay a return on the money invested.

The total length of track, including sidings, is 26 miles, the main line running from Hull through Deschenes and Aylmer to Queens Park being double-tracked throughout. It was intended at first to operate the line as a single track road with turnouts, but this was found not to be feasible on account of the number of train units. The right of way was therefore purchased outright from the C. P. R. and a second track was laid down. The rails are of steel, weighing 56 lbs. to the yard; and the ties cedar, of the standard

* Reproduced from the Street Railway Journal, New York.

dimensions, and laid 2,640 to the mile. On the whole line the number of highway crossings at grade is three, one overhead and one grade crossing being made over steam roads. The heaviest gradient on the portion of the line used for freight is 2 per cent.; there is one short grade of 26.4 feet to the mile, on the branch line running to Queens Park, over which there is no freight service.

POWER HOUSE.

In the power house located at Deschenes there are at present installed six 60 ins. new American vertical tur-

having been found sufficient to give a reasonably constant speed under the violent load fluctuations experienced when operating the electric locomotives.

CAR HOUSES.

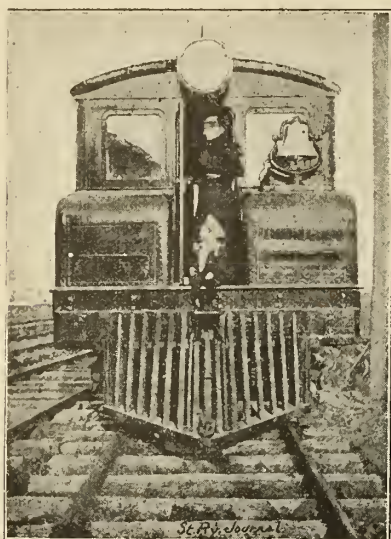
The car houses located alongside the main line at Deschenes are of stone, and consist of two buildings, each 150 feet long by 70 feet wide; each of these buildings contains four tracks, with pits continued throughout their full length; space is also given for an excellently equipped machine shop and for a tool house, store room and draughting room. A swinging crane is provided over the working pit and hydraulic jacks for handling the motors in the pits themselves.

ROLLING STOCK.

The rolling stock consists of thirteen double truck motor cars, of which four are closed and nine open; also of two single truck 21 foot cars for handling the local traffic in Hull. Four 13-bench open trailers are being added to the equipment this summer. The double truck closed cars are 40 feet 2 inches in length over all; vestibuled at both ends and finished both inside and out in solid mahogany; a special feature in the design of these cars is the use made for an observatory and smoking room of the vestibuled compartment at each end. The equipment for the double truck cars consisted originally of two 50 h.p. motors, but in practice these have not been found entirely satisfactory. The present standard equipment,

both for the open and closed cars, consists of four G.E. 1000 motors, geared to run at 25 to 30 miles per hour. This has been found by experience to be an admirable equipment for work of this class. The trucks used are of the Blackwell, Taylor & Brill make.

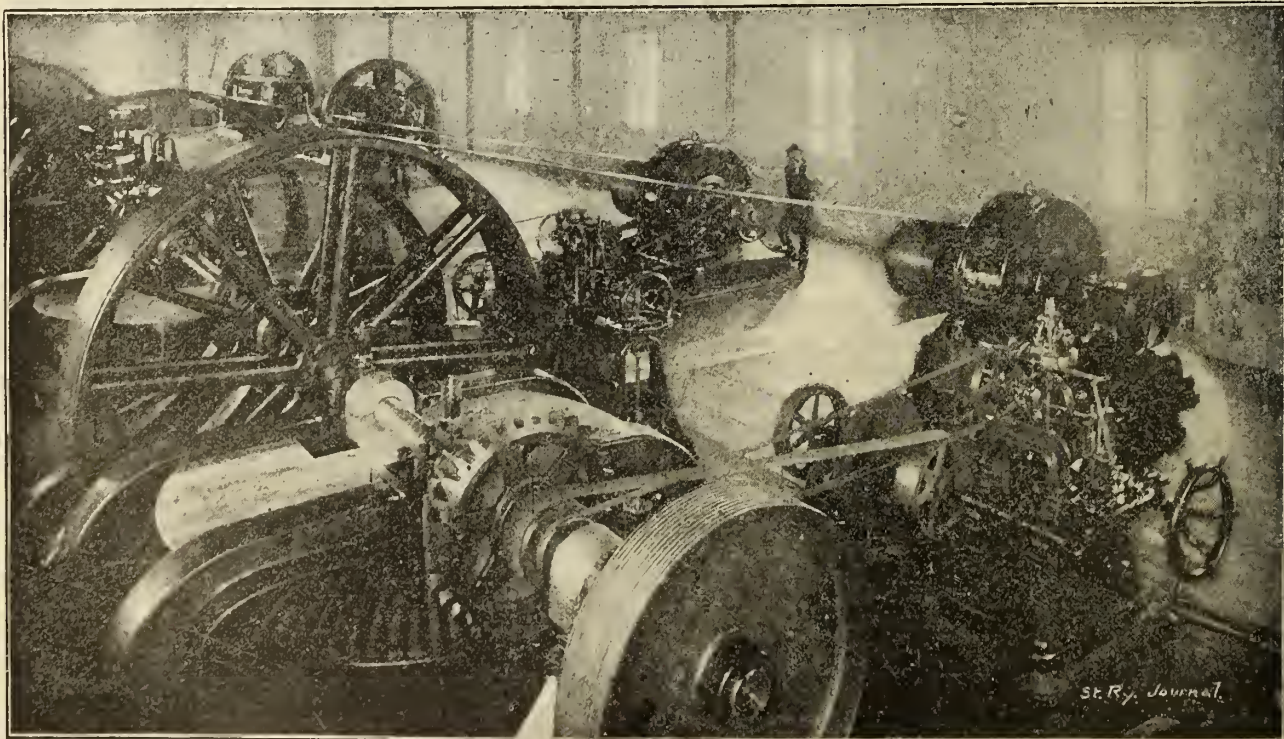
In addition to the rolling stock mentioned above, which is required for the purpose of handling the passenger traffic, the company operates two electric loco-



HULL ELECTRIC RAILWAY—END VIEWS OF LOCOMOTIVE (SUMMER AND WINTER.)

bines, built by Kennedy & Sons, developing at the normal head of 9 ft. 6 ins. 1,000 h.p., the jack shaft speed being 165 r.p.m.

The railway generators consist of two steel frame machines, of the Canadian General Electric Company's standard type, having a capacity of 325 k.w. each. Power is also furnished from the jack shaft to operate two 150 k.w. monocyclic alternators, from which



HULL ELECTRIC RAILWAY—INTERIOR OF POWER STATION.

current is furnished for the extensive lighting business of the Deschenes Electric Light Company in Hull and the city of Ottawa. The difficulties usually experienced in speed regulation with water power are largely overcome by the use of an artificial load, thrown on and off the generators by a very simple and positive method designed by the electrical engineer of the company, J. E. Brown, the use of water wheel governors alone not

motives, and an express, baggage and mail car, consisting of an ordinary closed body, mounted on double trucks, and equipped with two G. E. 1200 motors. The company has also a Ruggles rotary snow plough, and a snow plough manufactured by the Canadian General Electric Co. A most efficient aid in fighting snow, and one which has proved most effective during the past winter, even with storms that have stalled the steam

roads for several days, is the snow plough on each car, designed by Mr. Brown, and shown clearly in the engravings.

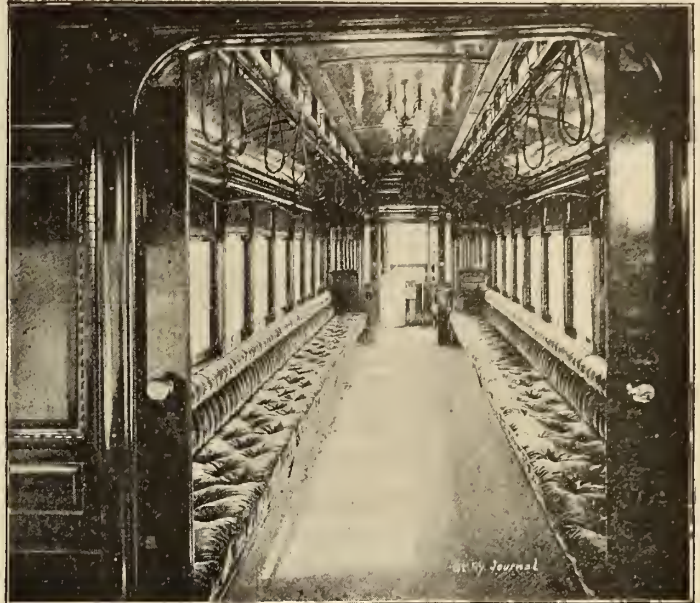
Of the two locomotives, both of which are in everyday use on the road, the first, which has been in operation since its starting up, two years ago, consists of a 22 ft. 8 ins. body mounted on heavy Blackwell trucks and equipped with four G. E. 1200 motors, geared to run at 20 miles per hour. The operation of this locomotive has been exceedingly satisfactory, its usual load being five or six loaded freight cars. Locomotive No. 2, which was placed in operation last summer, is a much more powerful machine, the body being 26 ft. in length and the equipment consisting of four G. E. 51 motors, capable of developing 80 h.p. each, mounted on McGuire "L" trucks with steel-rimmed wheels. Several improvements in the form of the body have been introduced, the most important being the lengthening of the cab and the placing of a door and passage at each end. The latter was rendered necessary by the inconvenience and danger experienced in handling the trolley where the ends are of the standard sloping style of the No. 1 locomotive. The No. 1 locomotive is provided with hand brakes only. The No. 2 machine is equipped with Standard air brakes, operated by a motor-driven compressor placed in the cab. The larger locomotive has been found in operation to be an exceedingly powerful machine, as many as thirty-three freight cars having been handled on a shunt; the ordinary load is twelve loaded freight cars. The car bodies and locomotive bodies were manufactured at the shops of the Canadian General Electric Company, by whom the entire electrical equipment used on the road has been provided.

The following statement shows the amount of freight carried, and the nature of the business done by the No. 1 locomotive during its first season. This, it should be remembered, was the first in which business was done and did not include twelve months of time, as the line was not put in operation until during the spring months. A very large increase in this business took place during the second season, rendering necessary the placing in service of a second and larger locomotive.

600 lbs. flour.....	60 tons.
88,200 bushels of grain	18,000 "
1,500 live stock	500 "
17,020,000 feet of lumber.....	25,350 "
2,000 cords of fire-wood	3,000 "
Manufactured goods.....	408 "
Total.	47,318 tons.

p.m.), eight for 25c.; red tickets, good between the stations mentioned on Sunday only, eight for 25c.; commutation tickets, giving sixty rides per month, \$5 for the first month, \$4.60 for the second month, and so on down to \$3 for the sixth month, and every subsequent month up to the twelfth; family tickets, 50 rides for \$4; school tickets, good only in Aylmer and Hull, forty tickets for \$1.

The officers of the road are as follows: President, Alexander Fraser; vice-president, W. J. Conroy;



HULL ELECTRIC RAILWAY—INTERIOR OF CAR.

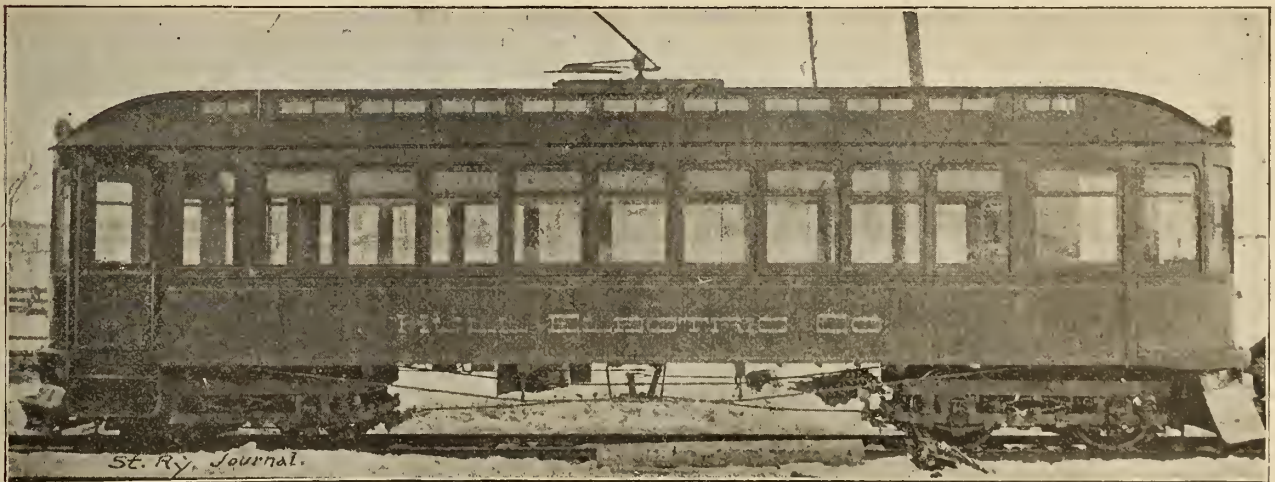
secretary, W. R. Taylor; mechanical and electrical engineer, J. E. Brown; purchasing agent, E. Seybold; trainmaster, C. Aird.

It is said that the Bell Telephone Company have decided to install a metallic circuit in St. Thomas, owing to the interruption by the operation of the street cars.

The ratepayers of Hamilton have voted in favor of extending the franchise of the Hamilton Street Railway Company for fifteen years, or until 1928. The vote was strongly against the corporation assuming control of the road.

Tenders are invited up to August 30th for supplying an incandescent electric light plant for the corporation of Beeton, Ont. Mr. John Galt, C. E. and M. E., is consulting engineer, and Mr. W. H. Mitchell chairman of the electric light committee.

The Charlottetown, P. E. I., Light and Power Company held its first general meeting recently. Mr. L. L. Beer was chosen president and



HULL ELECTRIC RAILWAY—40 FT. DOUBLE TRUCK ELECTRIC CAR.

An important feature in connection with the handling of freight is the low cost of locomotive repairs as compared with a steam locomotive. An additional and important saving is the greatly reduced cost for cleaners and attendants in the car-house.

The following are the rates of fare charged: Regular tickets, three for 25c.; white tickets (good between Aylmer and Deschenes, Tetreau and Hull, from 6:30 a.m. to 7:30 a.m., and between 5:00 p.m. and 6:30

Mr. Henry R. Lordly, C.E., engineer and manager. Mr. Lordly will go to England to consult with parties who control a new electric motor, to be used for street cars.

A company, known as the Metropolitan Electric Company, and represented by Mr. T. Lindsay, has made application to the city council of Ottawa for permission to sell electric light and power within that city. The company offer to supply electricity for one cent per ampere hour, with a discount of 40 per cent., and also a further discount of 12 per cent. for cash within 15 days, off the lowest net meter price. It will be remembered that recently the Deschenes Electric Company were refused a similar privilege as that asked by the Metropolitan Company.

SPARKS.

A company has asked the Dominion government for a subsidy for an electric railway from London, Ont., passing through Stratford, Arkona and Thedford to a point on the Georgian Bay.

An English syndicate has secured a controlling interest in the New Westminster and Burrard Inlet Telephone Company, which operates an extensive system, extending to the United States.

An important contract has recently been made between the Dominion Cotton Company and the Royal Electric Company, whereby the former are to install electricity as the motive power in their works. The contract calls for 1,500 horse power from the Chambly works, with the option of increasing it to 3,000, the contract to run for twenty years.

Experiments are being conducted on a system for telegraphing without wires between Lavernoch Point and Flat Holm Island, in the British Channel, a distance of $3\frac{1}{2}$ miles. The Morse code of signals is used and the messages are read by sound. It is stated that 40 words per minute have been signalled across and read without any difficulty. The system is the invention of W. H. Preece, engineer-in-chief of the English General Post Office.

The Montreal & Southern Counties Railway Co., which obtained a charter last year, was given power at the last session of parliament to extend its operations to the counties of Beauharnois, Chateauguay, Huntingdon and Napierville, and to increase its bonding powers from \$20,000 to \$25,000 a mile. Authority is also given to sell electricity for light, heat and power. Mr. Albert J. Corriveau, of Montreal, is the promoter of the scheme.

Mr. R. H. McCollum, son of Rev. J. H. McCollum, of Toronto, has invented an automatic brake for street cars, which was recently tested, with very satisfactory results, by the management of the Toronto Street Railway. The function of this new brake is to automatically work upon the trailer, which at the present time is acted upon by the old hand brake. Owing to the many duties of the conductor, the trailer breaks are seldom used, and the car rushes forward with such force that the trolley is driven ahead, despite its acting brake. With this novel brake, however, the car may be stopped, even with a loaded trailer behind, in a distance no greater than its own length.

Municipal trading in electric lighting fixtures has been declared to be beyond the powers of municipal corporations in England in the absence of legislative authority to that effect. The question arose, according to the London "Surveyor," at Leicester, where the town brought action to recover some \$25 from a tradesman to whom it had sold lamps and other fittings. The court decided that since the goods had been furnished they must be paid for, but that the plaintiff should bear the costs, and had clearly exceeded its powers. The town did not restrict its trade to patrons of its lighting plant, which might have altered the case, especially the supplying of lamps. The reasoning used in this decision would doubtless hold good on this side of the water.

Prof. Callendar, recently of the staff of McGill University, Montreal, has designed a platinum electrical resistance thermometer, capable of measuring temperature to the ten-thousandth part of a degree. The extreme delicacy of the instrument makes it a valuable aid in securing accurate observations of the temperature of lake and river water during the various seasons of the year, as no thermometer is available for such minute measurements. A long series of observations of the temperature of the St. Lawrence was made last winter by the McGill professors, in all of which the new instrument was used. By its aid it has been found that the greatest deviation that takes place in the winter during the ice-forming period, is only about one-thousandth part of a degree.

Mr. Henry Symons, Q.C., has had estimates prepared by eminent English engineers on the construction of the proposed works of the Welland Power and Supply Canal Company. This project involves the construction of a canal from the Welland River to the brow of the mountain at Thorold, a distance of 8 miles; the construction at Thorold of a power house, and from Thorold to Lake Ontario, a raceway by which to carry water into the lake. The estimate for the machinery to generate 100,000 horse power is £125,000; for transmission line to Toronto at a voltage of 10,000 and delivery of 50,000 horse power, £801,600; for excavation and other work connected with the undertaking, £1,525,062. The total estimate therefore amounts to £2,452,162, or roughly speaking, \$12,000,000. If the amount to be delivered in Toronto is reduced to 20,000 horse power, the project would cost \$1,000,000 less.

~ JAMES MILNE ~

Mem. Can. Soc. Civ. Eng. Late Gen. Sup't. Toronto Incandescent Light Co. Teacher Electrical Engineering, Steam and Steam Engine, Toronto Technical School.

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The directors of the Bell Telephone Company have decided to increase the capital of the company from \$3,168,000 to \$3,900,000.

John D. Banks, an engineer, of Toronto, committed suicide recently by inhaling gas. Deceased was at one time engineer at the Globe office.

The Western Electrical Construction Company recently commenced business at 210 William avenue, Winnipeg. W. T. Steward and F. Yates are the chief members.

The shareholders of the Montreal Island belt line railway authorized the directors to issue new bonds to the extent of \$380,000, and to cancel and redeem the old issue of \$300,000.

According to the daily press the Toronto Railway Company has entered suit against the Siemens & Halske Electric Co., of Chicago, for \$25,000 for breach of warranty of a generator.

The electric light plant at Tilbury, Ont., owned by Mr. R. H. Smith, was destroyed by fire on July 18th last. The loss is about \$4,000, two-thirds of which is covered by insurance.

The town of Brampton, Ont., has given a contract for electric street lighting to Pearen Bros., at \$50 per lamp per annum. The latter will install an arc dynamo and probably an incandescent dynamo.

The city council of St. Thomas, Ont., has granted a charter to the Peoples Telephone Co., capital \$60,000, to construct a telephone system in that city. The president is Mr. Joseph Mickleborough.

The corporation of Thorold, Ont., is advertising for tenders for the extension of the electric light plant, subject to the passing of a by-law authorizing the necessary expenditure. The estimated cost of the work is \$7,161.

A company has been formed, composed of Sir William Van Horne, Senator Proctor, of Vermont, Mr. Alger, secretary United States navy, and others, to develop the water power at Grand Falls, N. B., and transmit electric power north to River du Loup and south to Woodstock.

J. D. Kelly, a lineman employed by the Bell Telephone Co. at Peterboro, Ont., while at work aloft on Charlotte street, came into simultaneous contact with a live electric power transmission wire and a grounded telephone wire, mounted on the same pole, and was instantly killed.

The Bell Telephone Co., of London, Ont., are stated to have responded to the challenge of the Peoples Telephone Co., and lowered their rates. Telephones in residences have been reduced from \$25 and \$30 to \$20 a year, unlimited, and for doctors' and dentists' offices from \$35 to \$25.

TRADE NOTES.

The Babcock & Wilcox Company, of Montreal, have secured the contract for boilers for the new civic electric light plant at Granby, Que.

The Electric Construction Co., London, Ont., are installing a 6 h.p. motor and pump for the corporation of Burlington, Ont., to pump the water for street sprinklers.

W. Doherty & Co., organ manufacturers, Clinton, Ont., have installed two 15 h.p. multipolar type motors made for them by the Electrical construction Co., of London, Ont.

The Robb Engineering Co., of Amherst, N. S., who put in five of their Robb-Armstrong engines for the Halifax Tramway Co., are now putting one in the Union street station of the St. John street railway. It is a 300 horse power tandem-compound, side crank engine, medium feed. The Robb Company are now shipping engines to customers on the other side of the Atlantic. Three have been sent to the Isle of Man, for use by a tram company, and three more to Spain, and a seventh one will be shipped to Liverpool shortly.



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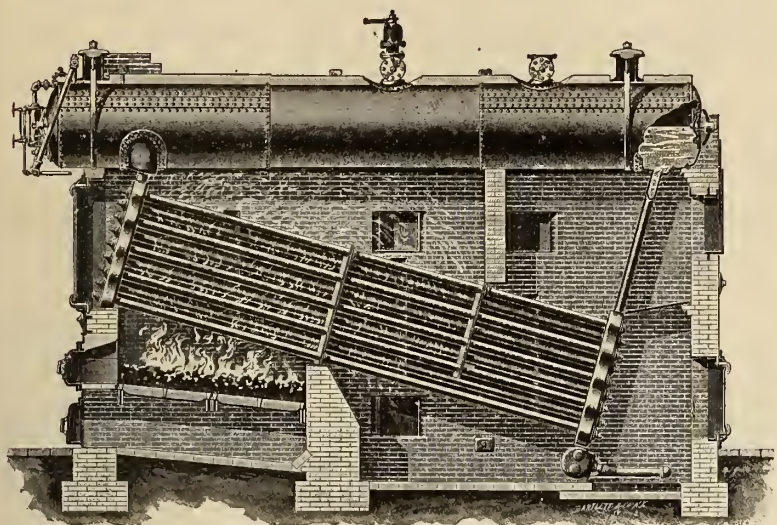
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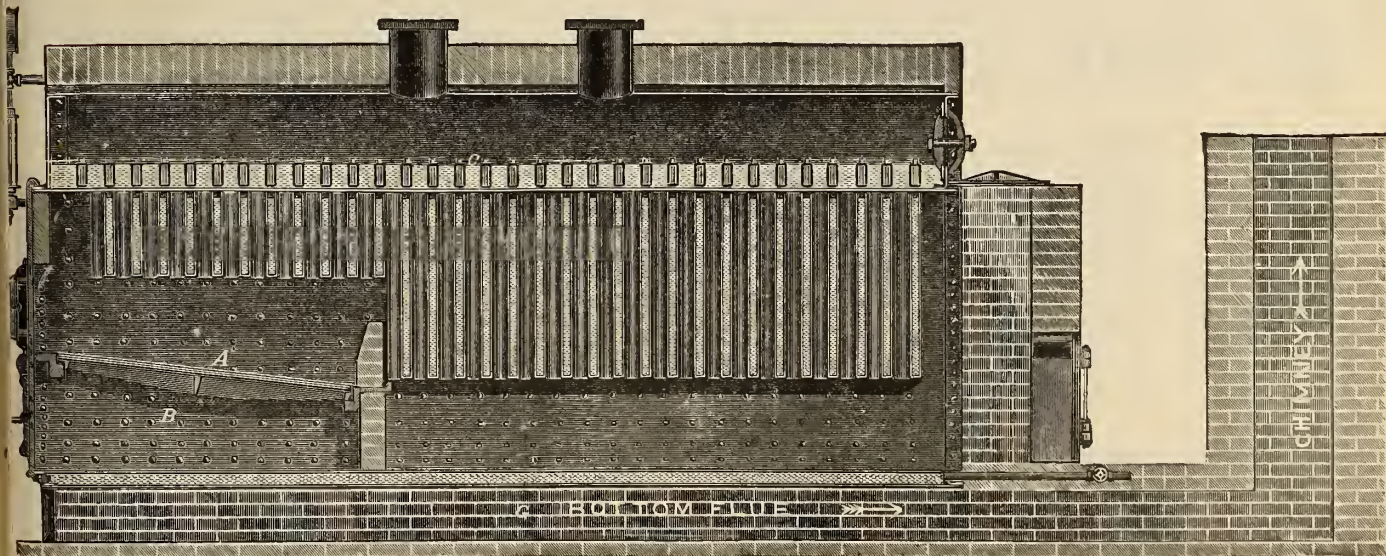
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CATALOGUE FREE

The directors of the Brantford Electric Light Company have instructed their manager, Mr. Wyse, to proceed at once to purchase the necessary plant for the extension of the works.

The Eastern Townships Light, Power and Carbide Company has decided to purchase the electric plant at North Hatley, formerly owned by Messrs. Edgar & Roy. The capital stock of the company is \$50,000. The officers are: A. J. Gordon, North Hatley, president; W. N. Walley, Sherbrooke, vice-president; Dr. Edgar, North Hatley, general manager; O. Roy, Montreal, secretary-treasurer.

The Ottawa Electric Company will increase their plant at No. 2 power house by adding a 60-inch water wheel and a 125-light arc generator.

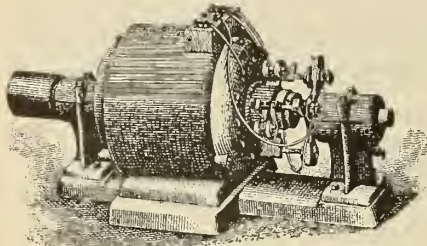
The Ontario Telephone and Switchboard Construction Co., Limited, has been incorporated, with a capital of \$75,000. It is composed of Messrs. Robert Fox, T. H. Smallman, F. B. Leys, T. H. Purdon, R. A. Bayly, John Labatt, Moses Masuret, John Milne, Dr. J. D. Wilson and J. R. Minhinnick, of London, and H. R. Evans and H. C. Walters, of Detroit.

THOS. L. KAY, Electrician and Manager.

T. O. APPS, Secretary-Treasurer.

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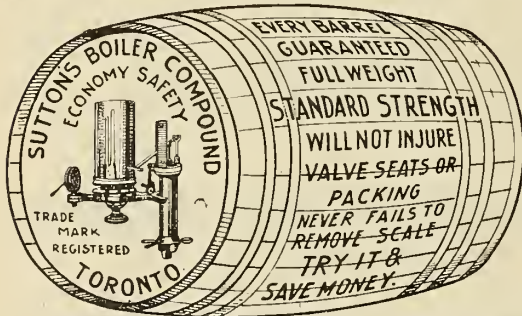
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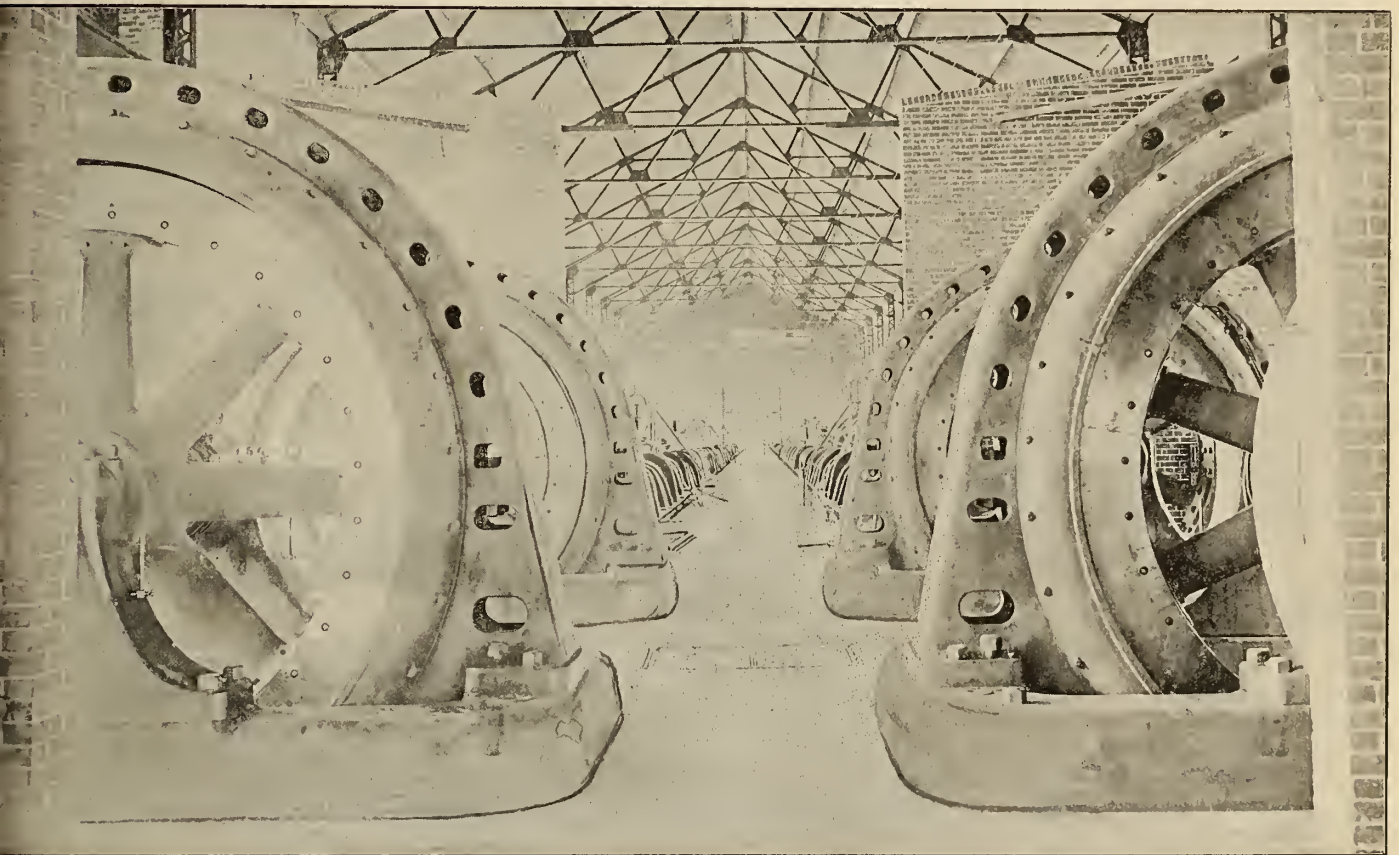
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At a recent meeting of the council of the town of Joliette, Que., Mr. L. A. Herdt, E.E., was appointed consulting engineer to the municipality.

Ephrem Valiquette, president of the Ingenieurs-Mecaniciens Association Canadienne de Secours Mutuels, who was the winner of the gold medal at the Industrial and Mechanical Course at the Monument National, Montreal, is provincial boiler inspector, and also a member of the Canadian Association of Stationary Engineers. He recently left the employ of W. Rutherford & Sons, and was presented on that occasion with a handsome silver water jug, as a token of respect. He is now foreman for Lymburner & Matthews, mechanical engineers, Montreal.

A valuable work has just been issued by Messrs. Longmans, Green & Co., of London, Eng., and New York. It is an exhaustive treatise on the direct current motor, the author being C. A. Carus-Wilson, late Professor of Electrical Engineering at McGill University, Montreal. The aim of the book is said to be to apply the principles of electric dynamics to the direct current motor. Although the discussion of elementary principles is omitted, the different subjects are treated in a very simple but concise manner. It contains over 300 pages, well illustrated and nicely printed. The price is \$1.25.

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A 30 K.W. Compound Wound Generator, 125 Volts. Must be in first class running order. Give make and full particulars.

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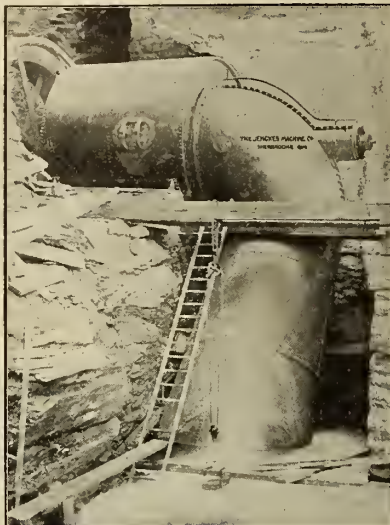
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45 inch Crocker Wheel in Horizontal Setting.

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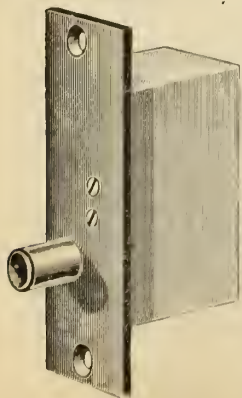
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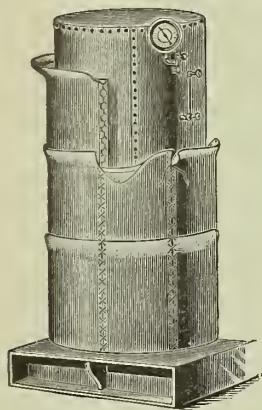
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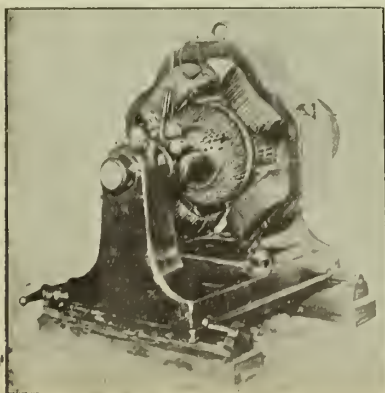
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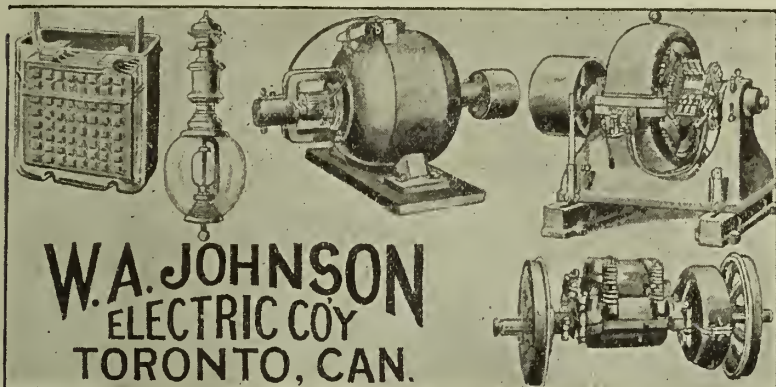
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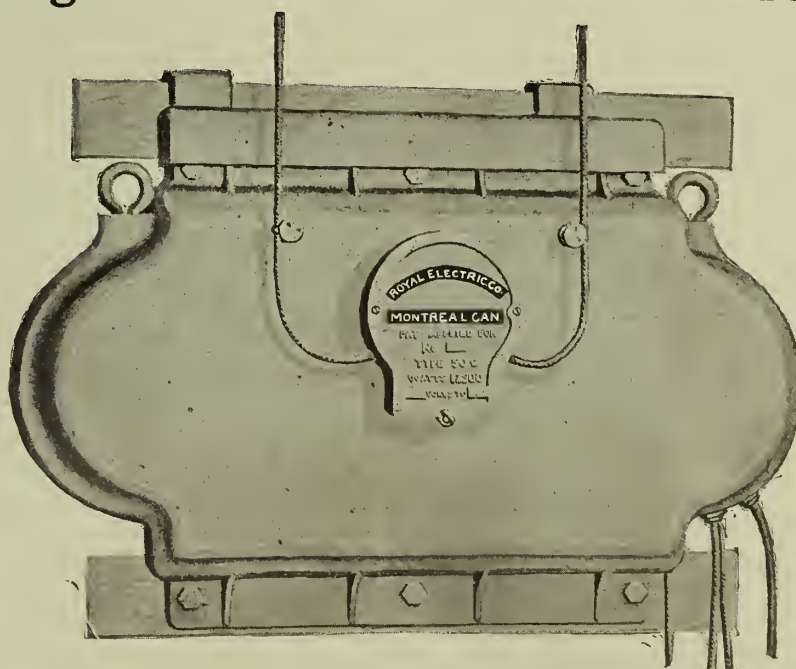
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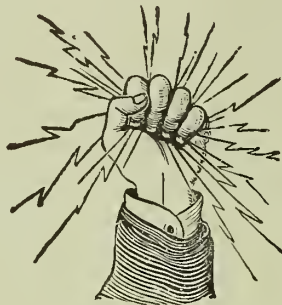
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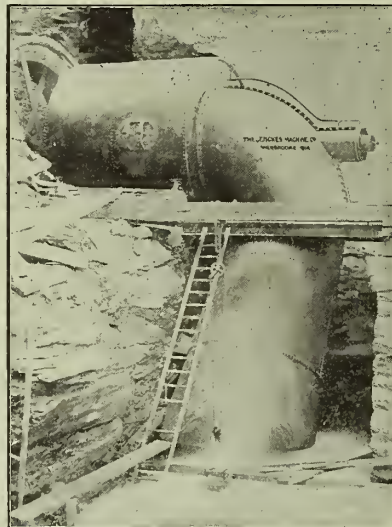
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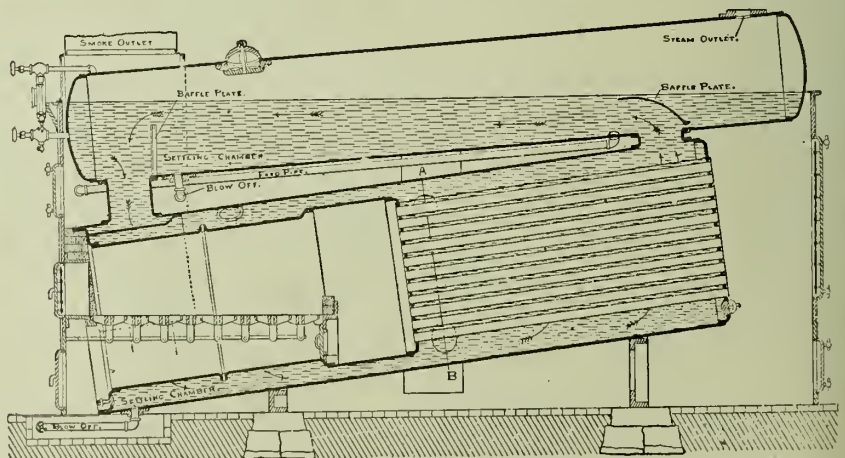
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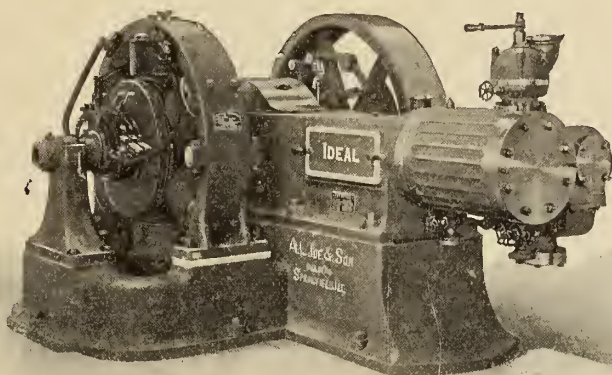
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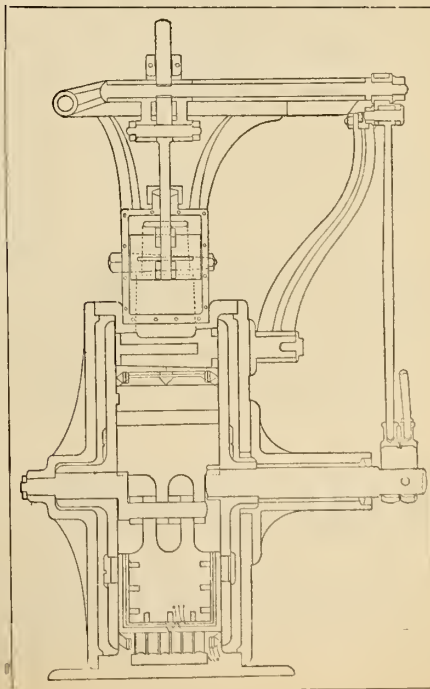
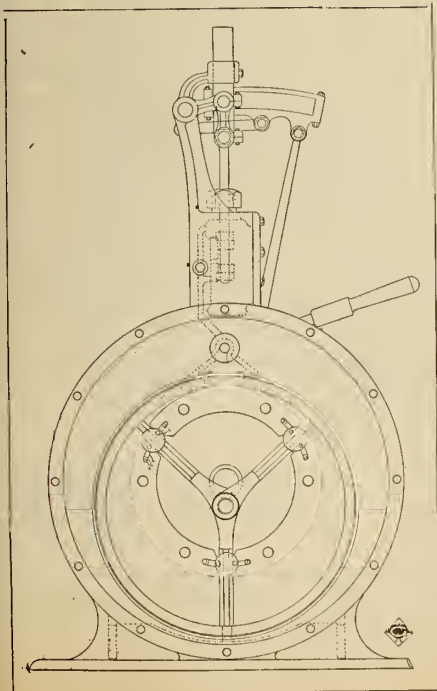
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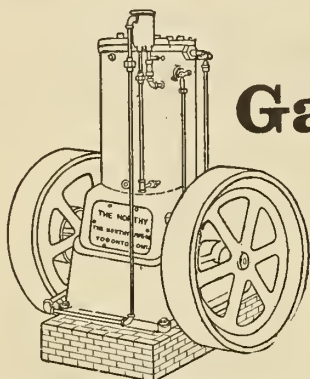
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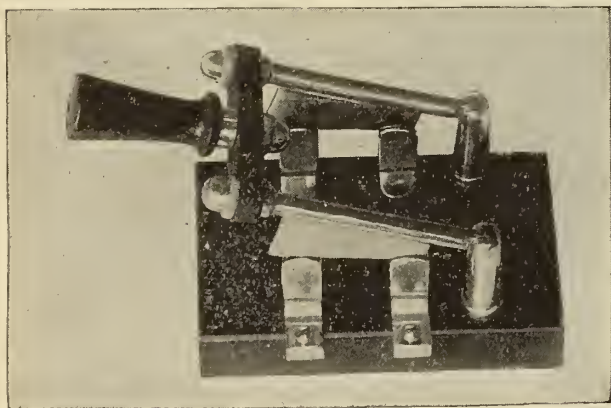
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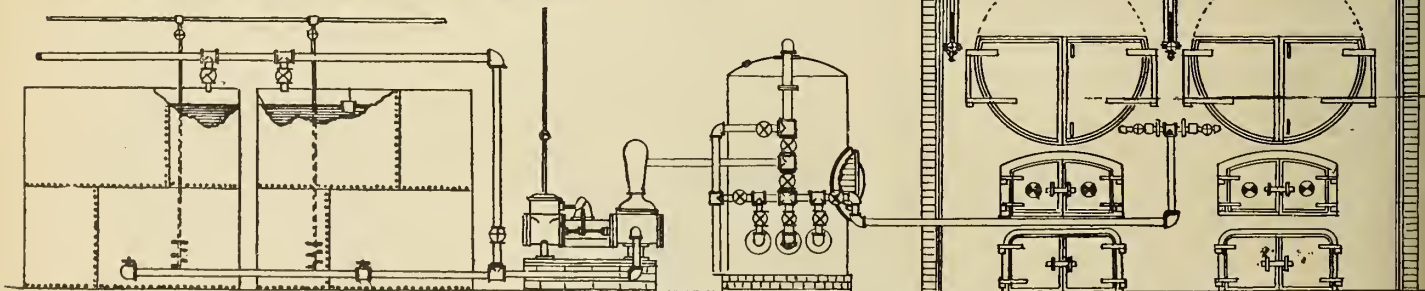
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CANADIAN
ELECTRICAL NEWS
AND
STEAM ENGINEERING JOURNAL.

VOL. VIII.

SEPTEMBER, 1898

No. 9.

**LONG DISTANCE TRANSMISSION PLANT OF
THE WEST KOOTENAY POWER AND
LIGHT COMPANY.**

THE falls of the Kootenay river, known as Bonnington Falls, in British Columbia, that have for some long time been an attractive field for the development of power, have now been harnessed and the power transmitted electrically to Rossland, the mining centre of the Kootenays, situated 30 miles distant.

Bonnington Falls is an ideal site for such a plant, the river at this point being 400 feet wide, while the water rushes over a high granite cliff, having a fall of 50 feet. At this point the Selkirk mountains rise to an elevation of over 3,500 feet above the sea level, the altitude of the river itself being about 2,200 feet, and the beautifully snow-capped peaks of the rugged range form one of the many charming and picturesque features that surround this extensive enterprise.

The determination to utilize the water power at Bonnington Falls for the development of power led to the organization of the West Kootenay Power and Light Company, which has installed and is now operating the interesting transmission plant about to be described.

The conception and commencement of the works are



FIG. 1.—CONCRETE DAM, SHOWING HEAD-GATE IRONS.

largely due to the efforts of Mr. Oliver Durant and Sir Charles Ross, Bart., the former as president of the company and the latter as director and engineer, in which capacity he devoted considerable time to the careful study of the engineering and financial problems involved.

The charter was obtained in the name of Patrick A.

Largey, president of the Centre Star Mining and Smelting Company, Oliver Durant, manager, and C. R. Hosmer, manager C. P. R. Co.'s Telegraphs, and was afterwards transferred to the West Kootenay Power and Light Company.

Primary surveys were made early in 1897, but it was July of that year before the location of the plant was



FIG. 2.—WOODEN DAM, SITUATED ABOVE CONCRETE DAM.

definitely settled and actual construction begun. The plans of the company contemplate the ultimate utilization of the entire three falls, which will give 60,000 h.p., the middle fall now being used developing 20,000 h.p.

POWER HOUSE.

The power house, shown on following page, is located on the west side of the dam. The foundations are built of cut granite; the walls of brick; the roof is of wood covered with galvanized iron; the station is 40 feet long by 60 feet wide, outside measurement, giving accommodation for two 725 k.w. and one 1,200 k.w. units directly coupled to horizontal water wheels. The height of the building from floor to ridge of roof is 40 feet, thus allowing ample room overhead for the handling of the machinery.

HYDRAULIC PLANT.

The dam, as shown in figure 1, extends across the end of the canal for a width of 60 feet. From the south corner of this dam the wing dam extends a distance of 120 feet, this being constructed of concrete, forming one side of the fore bay, which is also shown in figure 1. There is a rack

in the fore bay extending the full width of the dam, and the water, after passing through this, enters the penstock, and from the penstock flows to the water wheel casing, which is really a continuation of the penstock flowing from the draught tubes into the tail race underneath the water wheel house.

From the main water wheel casing there is tapped a 26 inch pipe, which conveys the water to a 50 h.p. horizontal wheel, which is used for running the exciter. The head has a maximum of 42 feet and a minimum of 34 feet.

WATER WHEELS.

The main water wheels for this plant were furnished by the Stilwell-Bierce and Smith-Vaile Company, of Dayton, Ohio, and are of their well-known Victor type. There are two pairs of 39" horizontal wheels in each case, which are connected directly to each generator shaft. These wheels are designed and guaranteed to develop 1,180 h.p. per set. In addition to the wheels just described, there are two pairs of 12 inch wheels of the same manufacture used in operating the exciters for furnishing the exciting current to the three phase generators in the station. The governors were also furnished by the Stilwell-Bierce and Smith-Vaile Company, and are of the Geisler type, driven by a belt connected on a small pulley on the water wheel shaft. Each governor operates the gates for each set of two wheels.

ELECTRICAL APPARATUS.

All of the electrical apparatus installed is of the Canadian General Electric Company's manufacture. In the generating station there are at present installed two 725 k.w. three-phase generators of the revolving field type, having 40 poles and operating at a speed of 180 r.p.m., giving frequency of approximately 60. These machines are shown in figure 2. They are of the well-known Canadian General Electric Company's

tilated by means of air ducts $\frac{1}{4}$ inch wide. The armature laminations are dove-tailed into the spider, thereby dispensing with the use of bolts through the core.

The bearings of these machines are of the self-oiling, self-aligning type, and the sleeves of cast iron lined with genuine babbitt metal. The base frame of these machines is so constructed that the armature may be moved parallel with the shaft in order that the field and armature may be repaired without tearing down. The



FIG. 4.—INTERIOR OF GENERATING STATION.

approximate weight of the revolving field is 27,000 lbs., the complete weight of each machine being 96,000 lbs. The generators are designated as A T 40-725-180, shunt wound, 1,100 volt generators.

The current is generated under a pressure of 1,100 volts and is conducted from the generator to the machine panels and from the machine panels to the transformer panels; from the transformer panels it is conducted to the primary side of the transformers and stepped up to either 11,620 volts when delta connected, or 20,100 volts when Y connected.

From the high tension side of these transformers the current is conducted to the high tension switches on the transformer panel, passing from there to the line panel, and thence to the line.

The transformers are of the air blast type, of 242 k. w. capacity each. There are at present installed two sets of three, which is ample to take care of the full current output of the generators. As a means of cooling, two 60" Buffalo blowers are used, the air from these being conducted through brick air ducts to the transformers.

Everything in connection with the power house is fire-proof in every respect.

THE POLE LINE.

The pole line is of a very substantial type of construction, being of round timber of specially selected cedar. The poles vary from 30 to 65 ft. in length, according to location. They are set 100 feet apart, or 50 to the mile, all corners and curves being properly guyed. A right of way 100 feet wide has been cleared



FIG. 3.—POWER HOUSE.

type, with pole pieces built of laminated iron thoroughly insulated from each other by a coating of japan.

The pole pieces, field coils and armature coils are arranged in such a manner that the windings may easily be removed without disturbing the armature or the magnet yoke. The field windings are wound on bobbins and thoroughly insulated with oiled linen. The armature is of the stationary type and thoroughly ven-

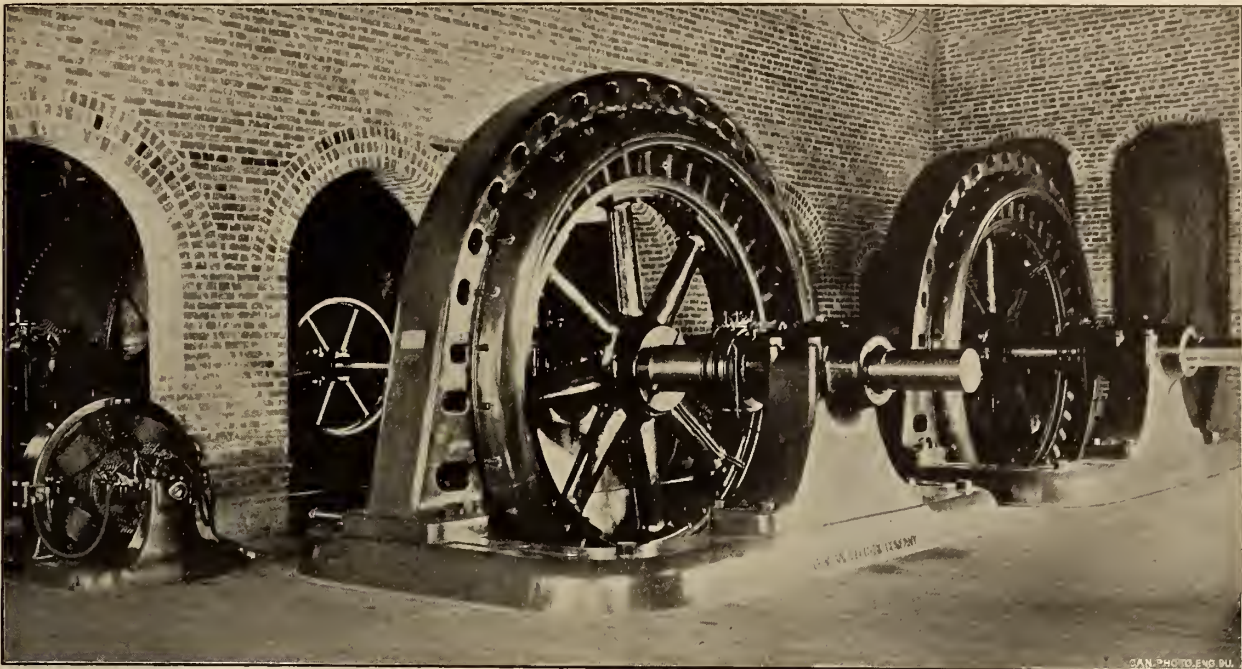
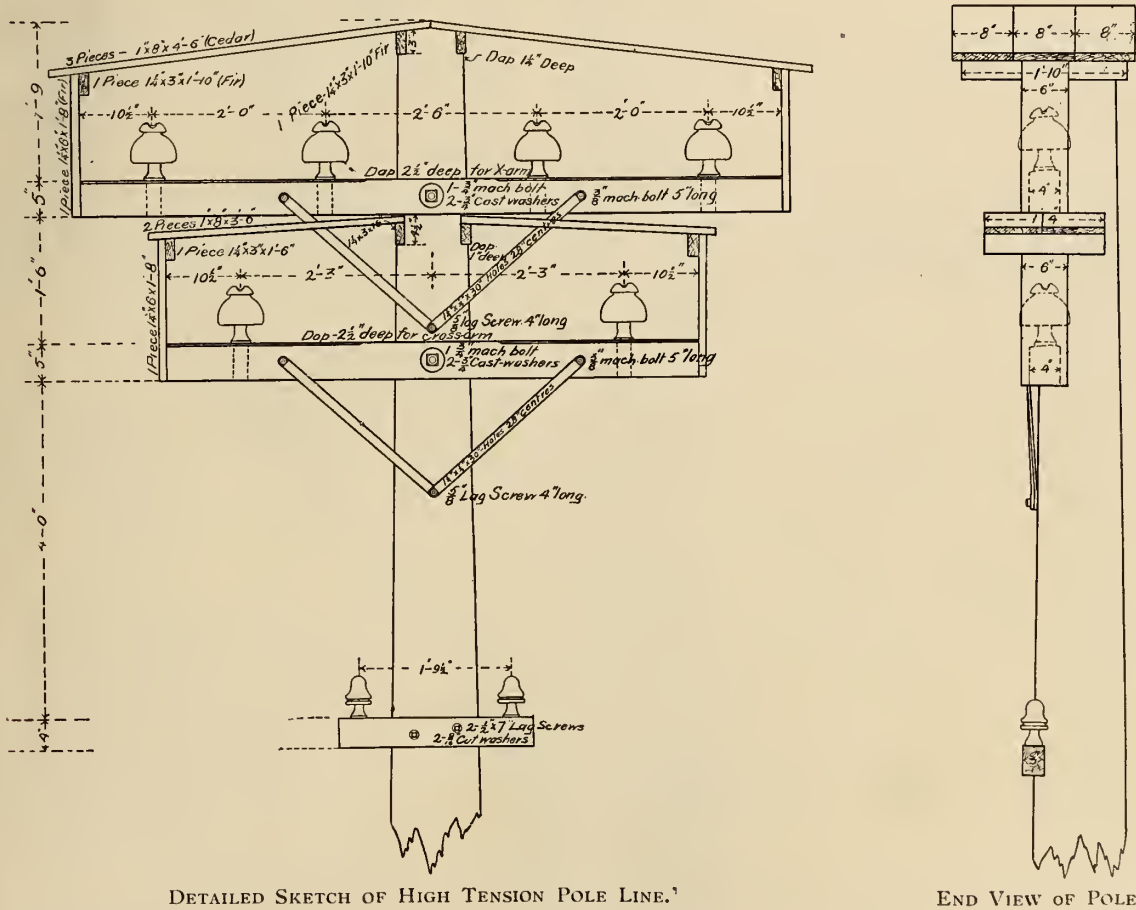


FIG. 5.--VIEW OF GENERATORS AND EXCITER.

throughout the whole route, which is heavily wooded.

The construction of the pole line embodies all the best features of most improved practices in transmission work, as shown by the accompanying sketch, giving all the dimensions and details of the construction throughout. The reader will observe that the

ever, and as the snow is of a very wet nature it piles up to a height of two feet on a cross arm 4 inches wide, remaining in this position until relieved by a chinook wind, characteristic in the western country. A single three wire, three phase circuit of No. 2 medium hard-drawn copper of Dominion Wire Company's manufacture extends from the power house to the sub-station



pole line has a housing 24 inches wide on each pole. On account of the many mountains encountered it was impossible to obtain a hanging insulator of sufficient mechanical strength to withstand the strain, and consequently the only way to overcome the difficulties encountered by wet snow was by the use of housing boards, as shown.

From the time winter sets in there is no wind what-

at Rossland, a distance of 30 miles by the pole line. The following shows the material required for one pole :

Two machine bolts, diam. $\frac{3}{4}$ in., length 14 in., thread 4 in. long, galvanized ; 4 machine bolts, diam. $\frac{3}{8}$ in., length 5 in., standard, galvanized ; 2 lag screws, diam. $\frac{5}{8}$ in., length 4 in. ; 2 lag screws, $\frac{1}{2}$ in., length 7 in. ; 4 wrought washers, diam. $\frac{7}{16}$ in. ; 2 wrought

washers, diam. $9/16$ in.; 4 cast washers, diam. $13/16$; 4 cross-arm braces, $1\frac{1}{4}$ in. $\times$ $\frac{1}{4}$ in. $\times$ 30 in., holes 28 in. centres; 6 high potential insulators; 2 S.P.E.L. insulators; 6 locust top pins, shanks 2 in. diam., 5 in. long, standard top; 2 oak top pins, $1\frac{1}{2}$ in. standard; 1 fir cross-arm, 4 in. $\times$ 5 in. $\times$ 8 ft. 3 in.; 1 fir cross-arm, 4 in. $\times$ 5 in. $\times$ 6 ft. 3 in.; 1 fir cross-arm, 3 in. $\times$ 4 in. $\times$ 2 ft. $3\frac{1}{2}$ in.; 6 pieces cedar, 1 in. $\times$ 8 in. $\times$ 4 ft. 6 in.; 4 pieces cedar, 1 in. $\times$ 8 in. $\times$ 3 ft.; 4 pieces fir, $1\frac{1}{4}$ in. $\times$ 6 in. $\times$ 1 ft. 8 in.; 4 pieces fir, $1\frac{1}{4}$ in. $\times$ 3 in. $\times$ 1 ft. 10 in.; 4 pieces fir, $1\frac{1}{4}$ in. $\times$ 3 in. $\times$ 1 ft. 6 in.

The telephone line, placed four feet below the lower cross arm, is of No. 12 B. & S. hard-drawn copper, transposed every pole. The insulators used are of the type C and Redlands type, while the pins are locust, boiled in paraffine.

SUB-STATION.

In the sub-station is installed a full complement of transformers, similar to those already described. These are wound for a secondary voltage of 2,200, it being the company's intention to distribute at this voltage, and step down a second time where a lower voltage is required.

In the sub-station there is installed the necessary high tension switchboard apparatus, as well as the 2,200 volt distributing board. On this distributing board is mounted total output ammeters, as well as ammeters and volt meters for the different outgoing circuits.

The switchboards throughout are composed of blue Vermont marble panels of the Canadian General Electric Company's well known interchangeable type.

The plant has now been in successful operation for the past two months, and although very severe lightning and rain storms have been of common occurrence, not the slightest difficulty has presented itself, when operating under a pressure of 22,400 volts. Several lightning discharges have frequently entered the generating and sub-stations, but these discharges were promptly taken care of by the banks of the well-known Wirt lightning arresters installed.

The personnel of the directorate of the West Kootenay Power and Light Company is: C. R. Hosmer, manager C. P. R. Co.'s Telegraphs, Montreal; Frank Paul, Belding, Paul & Co., Montreal; W. M. Doull, Doull & Gibson, Montreal; Sir Charles Ross, Bart., Balnagown, Scotland; Oliver Durant, J. B. McArthur and John M. Smith, Rossland. The entire plant is under the personal management of Mr. L. A. Campbell.

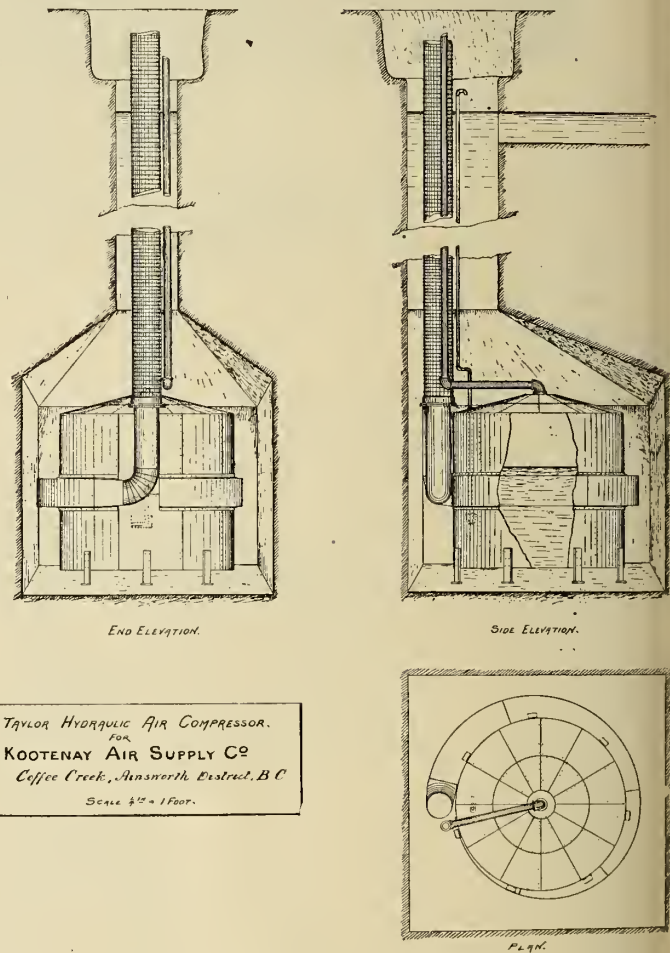
The Canadian General Electric Company have received an order from the corporation of New Westminster for one of their 150 kilowatt monocyclic alternators.

In the colliery districts of Derbyshire and Yorkshire, according to an English exchange, an electrical scheme on a colossal scale has been initiated. It is proposed to supply electricity for lighting, traction and other purposes to a district covering 2,000 square miles, and including the important cities and towns of Sheffield, Rotherham, Lincoln, Gainsborough, Newark, Nottingham, Ilkeston and Worksop. The generating station is to be at Worksop, which is in the midst of a great colliery district, where slack is plentiful at 2s. per ton.

COMPRESSED AIR PLANT AT AINSWORTH, B. C.

As a means of delivering power in long distance transmission, compressed air has lately been brought forward as one of the most economical systems, its advocates claiming advantages therefor over electric power. That our readers may understand the method of operation of a compressed air plant, and be in a position to compare the two systems, we print herewith illustrations and some particulars of the plant installed by the Taylor Hydraulic Air Company at Ainsworth, B. C., for the Kootenay Air Supply Company.

The system of utilizing compressed air is simple, its object being to supply air, uniformly in quantity and degree, by means of falling water. It relies upon the principle that falling water will entrain air and carry it down, producing compression as depth is increased, no moving machinery of any kind being required.



Coffee creek, upon which the works of the Kootenay Air Supply Co. have been constructed, is about two miles from Ainsworth, one of the oldest working mining camps in British Columbia. The creek is a rapid stream, with a flow of from 2,500 cubic feet to 8,000 cubic feet per minute, and a fall at point of utilization of one in ten. A dam, 5 feet high, has been built across the stream, and the water is conducted in a stave barrel flume 5 feet in diameter. The total length of the flume is 1,354 feet, and the pressure on same varies from five to ten pounds, dependent on the height of the stream. This flume, which is constructed with iron rods, cost about \$1.25 per foot, exclusive of grading. From the flume the water runs into a receiving tank, which stands on a trestle 110 feet above the surface of the stream at the point where the discharge takes place. From the bottom of the receiving tank, a pipe, 2 feet 9 inches in diameter, descends perpendicularly from the trestle to

the ground, and then down a shaft, which is sunk below the level of the creek at the point of discharge, another 105 feet. This shaft is 200 feet in length. It is called the down-flow pipe, and is terminated at the bottom of the shaft by a large bell-shaped tank, which is open at the bottom to allow the water to escape. The water is received through the flume into the upper tank, where it rises approximately to the level of the water in the creek at the point at which it is tapped by the flume.

In flowing from the receiving tank to the down-flow pipe, the water passes over the orifices of a number of small tubes, which at their upper end communicate with the atmosphere; hence, the atmospheric pressure drives the air into the water in innumerable small bubbles, which are carried by the water down the flow-pipe into the receiving tank. During their downward course with the water, the bubbles are compressed, the final pressure being proportional to the column of return water sustained in the shaft and tail-race. The head under which this plant will operate is 107 feet from the level of the water in the tank to the level of the water in the creek, and the back pressure of the rising water in the shaft will equalize the pressure in the down-flow pipe, so that the severest pressure at any point on the down-flow pipe will not exceed 60 lbs.

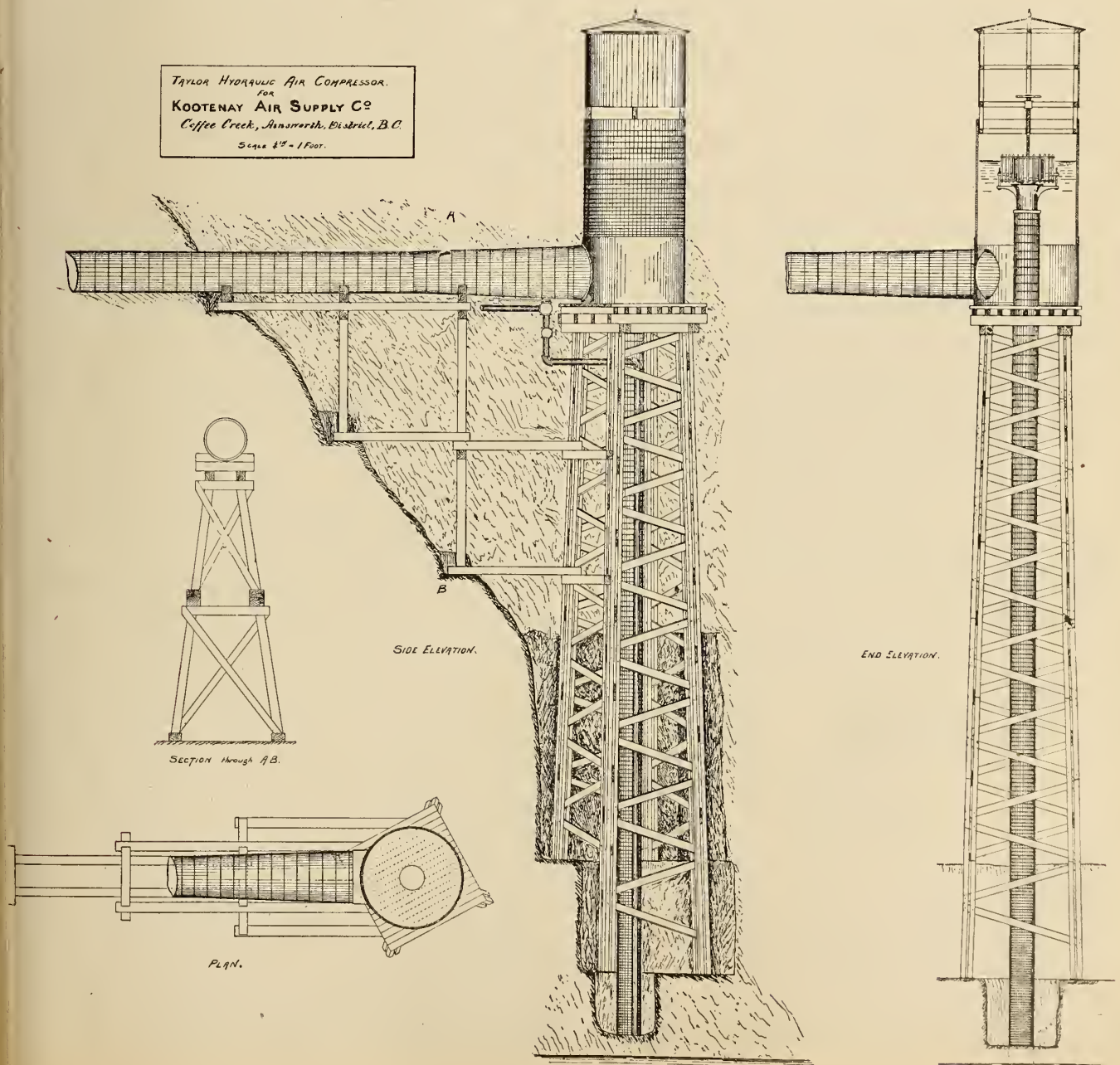
The capacity of the receiving tank in the plant of the Kootenay Air Supply Company is 533 cubic feet. It is 17 feet in diameter and nearly 20 feet high. The down-flow pipe penetrates some seven or eight feet into this tank, there entering a basin contained inside the tank, where the bubbles in the water delivered rise to the surface, and the air and water are separated. The

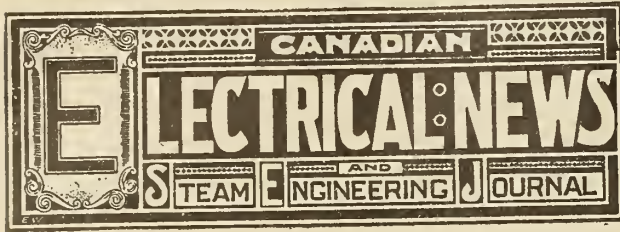
water passes out through the bottom of the tank, rises to the top of the shaft, outside of the down-flow pipe, a height of about 100 feet, and discharges itself again into the creek at a point about 100 feet lower down than that from which it is taken by the flume. The compression of the air contained in the receiving tank may be practically taken as that produced by the weight of water in the shaft outside the down-flow pipe, every 27½ inches of which accounts for a pressure of one pound per square inch.

The main pipe for conducting the compressed air taps the receiving tank at its highest point, and from the main service pipes conveys power for considerable distances for drills and other mining machinery in the vicinity. The plant is said to automatically regulate itself by means of a pipe led upwards until it reaches the level of the water in the tail-race, so that when more air is being compressed than is required, the water in the tube is ejected, and air passes up the pipe until the level of the water in the receiving tank is again higher than the opening of the tube.

The air is being delivered at a pressure of about 90 pounds, and is carried through a nine-inch main for two miles to the centre of distribution. It is claimed that this pipe line will convey between 400 and 500 horse power with a loss of not more than 10 per cent., and that it will discharge 4,600 cub. ft. of free air per minute.

The Kootenay Air Supply Company are said to be selling power for air drills, on the 24-hour run, at \$3 per day, and it is estimated that an air drill will consume from 80 to 120 cubic feet of air per minute. The total cost of the plant is given as \$30,000.





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Competition in the lighting and power companies have suffered much injury in the past by the

operations of persons who, with little or no knowledge of the business, have proceeded to organize companies and enter fields already thoroughly exploited, slaughtering prices on all sides. There have been instances in Canada where, in towns of two thousand population, a new company has started up in competition with an existing company, the invariable result being disaster to both. In larger towns and cities conditions are to a large extent the same. The imaginary profits which electrical companies are supposed to be making, and a lack of knowledge of the expense and difficulty entailed in the operation of an electric plant, are probably the incentives which induce the promoters of new companies to invest their money in competitive undertakings. They give little consideration to the conditions as they are experienced after the franchise is secured and the plant put into operation. Then they find that the operating expenses are heavy, that maintenance and insurance represent a considerable expenditure, and that owing to variation in the load, characteristic of both lighting and power, a greater capacity in machinery must be installed than would otherwise be found necessary. There are few, if any, electrical plants in Canada paying more than a fair dividend on the capital invested, and until the cost of installation, operation and maintenance is reduced, electric light and power cannot fairly be sold at a price much lower than at present. There are, however, towns and villages in Canada in which electricity has not yet been introduced, and which would seem to offer more promising returns to prospective companies.

Peat Fuel.

In this issue some particulars are given of the steps that have been taken looking to the employment of compressed peat as fuel. The development of this industry has been watched with keen interest, but until recently the success attained was not encouraging to the persons interested. It is said that as early as 1866 air-dried peat was used upon the eastern division of the Grand Trunk Railway, but because of the bulk and uncleanness of the crude material, its use was discarded. It would now seem that a process has been perfected which overcomes many of the difficulties previously met with, and unless unforeseen obstacles arise, there would seem to be a promising future for the industry. It is indeed gratifying that a Canadian is again to the front with patents, covering not only Canada, but also Great Britain and the United States, for the utilization of what has heretofore been a waste product. The experiments made with compressed fuel under Mr. Dickson's patents have given exceptionally good results, showing the material to be equal to anthracite and greatly superior to slack coal, while it certainly possesses advantages, such as less smoke and ash residuum and practically no offensive gases. Steam users will welcome the advent of any innovation the object of which is to place upon the market, at less cost, a fuel equal to or better in quality than coal. The cost of coal, due in a large measure to high freight charges from the United States, has greatly retarded the development of the natural resources of Canada and checked enterprises which, under more favorable circumstances, would have given employment to a vast number of workmen. With a cheap and satisfactory

fuel at our doors, we may reasonably anticipate the greater development of our mines and the establishment of smelting works and other industries which are dependent on cheap fuel. It is yet somewhat premature to attempt to forecast the effect which the discovery of this process of manufacturing compressed peat fuel may have upon the electrical industry, but it would appear as likely to result in the greater employment of steam in competition with water power.

Future of the Storage Battery.

THE storage battery is to-day regarded with much less skepticism than a few years ago. As with all innovations and new inventions, practical demonstrations were required to convince an incredulous public that the principles involved were capable of practical application. With the growth of the storage battery industry has come a vast improvement in apparatus, in keeping with the advancement made in other branches of electrical work. Referring to recent developments in the applications of storage batteries, Mr. Joseph Appleton, in a paper read before the Engineers' Club of Philadelphia, points out that the Chicago Edison Company have installed a storage battery plant, the plates of which weigh over one million pounds, being capable of delivering 2,000 horse power for one hour. As showing the connection of the storage battery with the development of water powers for the generation of electricity, he cites the installation of a plant by the Buffalo Street Railway Company, operated in connection with a booster, which compounds it to any desired extent. Other fields in which there would seem to be a future for the storage battery are for furnishing power for car lighting, elevator service, telephone exchanges, and electric vehicles. There are certainly indications that the era of the electric carriage is near at hand, and that the next few years will witness a considerable development along this line in Canada. Proof of this is found in the appearance on the streets of Toronto of an electric delivery waggon, used for a commercial purpose only, and driven by two motors controlled by storage batteries.

The Kootenay Power Plant.

THE electrical development of the water power of the Kootenay river at Bonnington Falls, in British Columbia, and the successful inauguration of the plant, marks another step in the advancement of the electrical industry in Canada. This plant has been in operation for a sufficient time to demonstrate its thorough practicability, the machinery having moved with perfect smoothness from the beginning. While in general design the plant of the West Kootenay Power and Light Company does not differ from others installed in Canada, as for instance, one at Goldstream, in the same province, yet there are certain features in connection with its construction and operation that are quite unique and interesting. From an engineering standpoint the most characteristic feature is the method employed for the protection of the pole line from the climatic conditions peculiar to British Columbia. As is well known, the snow is of a wet, sticky nature, which, with the absence of wind, necessitates the construction of housing boards over each pole to protect the insulators and prevent short-circuiting. Two points in connection with the operation of the plant represent comparatively recent developments in the science of electricity in Canada. One is the high voltage employed, and the other the distance to which the

current is transmitted. The use of such a high voltage as 22,000 is now considered quite feasible, owing to improved methods of insulation and the perfecting of safety devices, while the lessening of the loss in the line has rendered it practicable to transmit the current a distance of thirty miles, which is the length of the transmission of the plant in question. Almost simultaneously with the starting up of this plant, the machinery of the Cataract Power Company, of Hamilton, was also set in motion, the current being generated under a pressure of 22,500 volts and carried to a transformer station thirty-five miles distant, for distribution. These two plants, it is believed, will prove to be only forerunners of many other similar installations in Canada, some of which are expected to take definite shape at an early date.

ELECTRICAL EXHIBIT AT TORONTO EXHIBITION.

ONLY four electrical companies are this year represented in the machinery building at the Toronto Industrial Exhibition. Entering the building from the east we find the Royal Electric Company, of Montreal and Toronto, occupying their usual space, with a creditable exhibit under the superintendence of Mr. A. E. Payne, of the sales and engineering staff of the company. In their space proper, about 50 by 40 feet, they show one 75 k.w. S.K.C. dynamo, twenty 60 k.w. and one 40 k.w. dynamos, a full line of direct current motors and S.K.C. alternating current motors, together with transformers, street car motors and controllers, alternating current arc lamps, incandescent lamps, lightning arresters and switches, and a line of beautiful ammeters and voltmeters, made entirely of porcelain and glass, which are attracting much attention. There is also a fine marble switchboard, fitted up with all necessary instruments, including the latest novelty in the way of high tension switches, being a sliding contact switch, which is regarded as a vast improvement over the former style. A pyramid of rubber covered wire of different sizes is also exhibited in this space. In another part of the building the Royal Electric Company have in operation one type B 60 k.w. S.K.C. dynamo furnishing current for their exhibit, and two 50 light T. H. arc machines, supplying current to 100 arc lamps of 2,000 c.p. on the grounds and in the buildings.

The W. A. Johnson Electric Company are located in the same space as last year and have an attractive display, the feature of which is a 45 k.w. inductor alternator which the company have lately placed on the market. It has a steel frame, a new style of base, and a two coil field, giving perfect magnetic symmetry and inherent regulation. It has no commutator or collector rings, and there is an entire absence of heating. Two other machines are also in operation, furnishing current to incandescent and arc lamps and for power purposes. Transformers, motors, switchboard apparatus, electric fan, etc., complete the exhibit.

The Electrical Construction Company, of London, Ont., have on view their latest type of multipolar dynamos and motors. These they claim are second to none, their dynamos being especially adapted for direct current isolated lighting, and showing an efficiency in actual work of 90 per cent. Bipolar types are also exhibited, as well as a complete line of electrical supplies.

Motors, dynamos, telephones, switchboard and instruments, lamps and electric fans comprise the chief features of the display of the Jones & Moore Electric Company, of Toronto, who are gradually working their way upward in the electrical field.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

NINTH ANNUAL CONVENTION.

UPWARDS of fifty delegates were present at the ninth annual convention of the Canadian Association of Stationary Engineers, which opened in the Oddfellows' Hall, John street north, Hamilton, on Monday, August 8th last, at 11 o'clock a.m. Mayor Colquhoun, on behalf of the City Council, delivered an address of welcome to the engineers, expressing the hope that a successful meeting would follow. Aldermen Carscallen and Nelligan also spoke, endorsing the sentiments of the Mayor. The latter gentlemen, after reading the Association's preamble, advised careful consideration on the part of the engineers in their legislation. On behalf of Hamilton branch No. 2, the President, Mr. Robert Mackie, extended a hearty welcome to the delegates. The above felicitations were acknowledged by Mr. E. J. Phillip, Executive President, of Toronto, who appointed a committee, consisting of Messrs. Jas. Ryan, A. M. Wickens and W. G. Blackgrove, to draft a reply of thanks. This committee prepared the following response, which was afterwards forwarded to the Mayor:

"We, as a body of engineers, extend to you our hearty appreciation of your cordial and kindly address of welcome to your pleasant and prosperous city at our ninth annual convention.

"We, as a body of workmen, do not believe in the furtherance of strikes or labor troubles of any kind. We are organized for educational purposes, in order that our employers may be benefitted thereby, and thus ensure for them efficiency, carefulness and stability to reduce operating expenses generally. It is our aim to advance the interest of those by whom we are employed. It may be interesting for you to know that there are members of this association who are worth 100 per cent. more to their employers to-day than they were ten years ago, thus showing that their admission to the society was to their benefit as well as to that of their employer.

"It is not our intention to laud our society as being the best on earth in regard to benefits, such as insurance, sick benefits, etc., but we do maintain that our society is the best organized for the advancement of its members in their calling.

"We are pleased to meet in your beautiful city, and trust that our meeting here may be beneficial to you and the manufacturer and steam user, as well as to ourselves, and hope that we may meet here again some time in the future.

"We wish to thank you for the hearty reception you have accorded us, and we assure you that we feel entirely at home here. We shall endeavor to conduct our business in the best manner possible, and trust our deliberations may be profitable to one and all.

THOS. RYAN, Montreal.
A. M. WICKENS, Toronto.
W. G. BLACKGROVE, Toronto."

PRESIDENT'S ADDRESS.

The President, Mr. E. J. Phillip, then read his annual address as follows:

I have the honor and pleasure to welcome you to this, the 9th annual convention of the C.A.S.E. The subordinate associations have chosen you to represent them at this convention, and to look after their individual interest in particular and the whole society in general. The second meeting of the executive—it was really the first, the previous one being only a meeting to get into shape—was held in this city, and I little dreamed at that time that I would occupy the president's chair at the next meeting in Hamilton; therefore, it is with pleasure that I greet you, the new members and the jolly good fellows I have met before.

While this meeting should be a criterion by which we can judge the growth of the association, we must not forget the conditions under which the C.A.S.E. is carried on. First, it is not a labor organization, nor is it an insurance society, and it cannot be called a secret or benefit society, nor is it a political or religious order; it is purely an educational institution. Therefore the growth of the order is limited for several reasons. We have not the attraction that insurance, secret, benefit or labor organizations have. The field from which we draw our members is limited and scattered, and there are few places where there are plants enough to get a number of engineers to join an association; another reason is the fact that as boys at school hate to be taught, so we grow up, and it is hard to get a man to realize that he has much to learn, and as education is the only object for joining the association, some object to letting the public know that there is anything yet for them to learn. Now, while the growth of the order is apparently small, at the same time the percentage of good done its members is much greater than any other order that I know of, as many can testify to. We meet again here this year to try and work out other ideas for the benefit of the order and each member individually.

I hope you will all give your attention to the business that will come before you, that our meeting here may result in profit to ourselves and prosperity to the society. The prospects for the

coming years are brighter than for years past; times are good in this country, and when the war is settled the big country to the south of us will brighten up and their prosperity will add to ours. So that if we have grown in the past few years we will boom in the next. Hard times have had their effect on this order like all others, but hard times are a thing of the past in this country, and will be for some time to come, if I am any prophet, and if those who have been the stay of the association in the past will keep on pushing they will reap the harvest they have been looking for.

Better work has been done in the subordinate associations during the past year, in the line of reading papers and making the meetings entertaining and instructive, than other years; and it is noticeable the improvements in lodges where this matter is thoroughly carried out. I am pleased to state that Hamilton No. 2 is carrying this work out to perfection. There was one new association formed during the year in Toronto. It is a good live association and will materially help the order in Toronto and vicinity. The matter of a hand-book taken up last year was completed this. The secretary will no doubt make you a full report on the matter. I have not had the time to give to executive business that I would like, from the fact that this has been the busiest year with me that I ever experienced, in fact, it was very difficult to get away to attend this convention; in consequence of this the work has all devolved on the secretary, and, as in past years, the secretary is by far the most important officer of the executive. So much so that it has been suggested that a permanent secretary be appointed, or at least have the secretary hold office for more than one year. As it is now, it takes a man the entire year to get accustomed to the work, and then he is changed, making confusion and loss of time to both executive and subordinate lodges that would be avoided by a permanent secretary. In conclusion, brethren, I hope you will give me the support that you have given the chair in the past, and that you will attend strictly to business while there is business to be done. I wish it were in my power to do all for the C.A.S.E. that I would like, and place it at the head of all societies, where it belongs, because it is founded on education.

After the reading of the above address, the minutes of the last annual meeting, held at Brockville, were read and confirmed. The following committees were appointed:

Credential Committee—George Mackie, Peter McNaughton, George C. Mooring.

Audit Committee—W. J. Webb, Peter McNaughton, Wm. Bear.

Constitution Committee—Thomas Ryan, G. C. Mooring, Wm. Allen, Thos. Pilgrim, George Mackie.

Good of Order Committee—J. M. Dixon, W. F. Chapman, Thomas Eversfield, G. C. Mooring, J. J. Richardson.

Mileage Committee—R. C. Pettigrew, Joseph Robinson, John Fox.

Notice was given by a Toronto delegate that he would move that several minor changes be made in the constitution of the Association, after which the meeting adjourned until 10 a.m. the following day.

SECOND DAY.

After the roll call, Mr. J. G. Roberson, Secretary, of Montreal, read his annual report, which stated that during the year two associations, viz., Stratford and Warton, had been reorganized, and were now in a prosperous condition. The Treasurer reported that the total receipts for the year were \$559.99, and the balance now in the treasury \$290.04. No returns could be made regarding the hand-book issued by the Association until next year. It was likely to prove a financial success. Some discussion arose regarding the proposition to reduce the per capita tax from 70 cents to 50 cents a member, which was defeated. The above reports, as well as that of the auditor, were adopted.

A discussion followed on several proposed alterations to the by-laws. The proposal to do away with the offices of door-keeper and conductor was defeated, as was also the amendment to article X, which recommended that the executive officers do the work of the district deputy. It was decided to allow past-presidents the privileges of the convention, but that they should receive nothing for expenses. The Educational Committee presented its report.

On motion of Mr. J. M. Dixon, seconded by Mr. W. F. Chapman, it was resolved that the Executive Secretary should be appointed for two years instead of one. A proposition that the convention be held bi-ennially instead of annually in future was defeated. Mr. J. D. Taylor, of the International Correspondence School of Scranton, Pa., addressed the meeting, after which a resolution was passed recommending the school to all stationary engineers.

In the afternoon the visitors enjoyed a sail on the steamer "Acacia," and in the evening, at 8 o'clock, again assembled for business. Mr. E. G. Barrow, city engineer of Hamilton, presented a paper on "Sewage Disposal Works." Mr. Barrow briefly described the various methods of purification, and gave some interesting particulars of the sewage disposal works recently completed for the city of Hamilton under his supervision. A paper on "Oils in the Engine Room" was read by Mr. J. S. Williams, chemist. This paper was to a large extent a reconstruction, with some additional data, of a paper read before the Hamilton Association last spring, and which has already appeared in this journal. An interesting discussion followed relative to the various classes of oils, and their special uses. The following paper was read by Mr. P. McNaughton, of Montreal:

EVAPORATION AND THE RAISING OF STEAM IN BOILERS.

By P. MACNAUGHTON.

FROM the title of this paper you will notice that it is to deal with two things: First, evaporation, and second, the making of steam in boilers. These two actions are often considered as if they were distinctly different, but I think it can be shown that the actions are the same in the end, and that they differ only in the way in which the end is reached. In the following remarks it will be noticed that I have tried to show how the natural action of evaporation resembles the action of making steam for power, because it is always instructive to think out how the processes which we make use of every day compare with corresponding ones in nature. Some have said that it is wasting time thinking of things in this way; if they really think so it would be wasted time; but to others it would be very instructive and pleasurable. I might say that such thoughts would be to them as salt, which, though of little use in itself as a food, still makes our food more palatable. Strictly speaking, the term evaporation is used to denote nature's method of changing water into vapor, and making steam in boilers is part of man's method of changing water into vapor, through an intermediate state familiar to all of us called steam.

The principal actions in nature in which evaporation plays a part have been noticed by all of us; they are the disappearing of the dew from the grass on a summer morning, and the frost later in the season, the disappearing of water when left standing in open vessels, and on a much larger scale the raising of water from our rivers, lakes and surrounding ocean. Now, it is usually admitted that for every action there is a cause, and the cause of evaporation in nature is the heat of the sun. It will make our problem much simpler if we consider, for instance, a bucket of water as made up of a great number of particles of water. That this is the real state of water will be seen at once if we remember that when heat is applied to water it forms steam, which is particles of water visible to the eye, and if heat be applied to steam the particles of steam are divided into smaller particles called vapor, which is invisible.

Atmospheric air, among other things, contains a certain amount of water vapor, and this water vapor as long as the sun is shining, is kept suspended uniformly through the atmosphere by the sun's heat. When the sun has set and its heat no longer acts on the atmosphere, this water vapor tends to condense to a slight extent, and with this condensation it becomes slightly heavier than the other components of the air, and so tends to sink towards the earth, so that in a calm, clear night in summer that part of the atmosphere lying next the earth contains more moisture than that which is higher up.

That the above statement points out the true state of the atmosphere at night is proven by noticing the land fogs. If we go up a mountain at the first of daylight on a calm, foggy morning, we will notice that as we ascend the fog becomes less dense until, when we have gone up about four or six hundred feet, we will be out of the fog altogether.

This layer of moist air coming in contact with the cool leaves of trees, plants or other vegetation, the water vapor which it contains is further condensed, thus forming dew. I wish it to be clearly understood at this point that the collecting of dew on the leaves of plants is owing to condensation and not to a falling of water as rain. The fact that dew only gathers on the top side of the leaf and does not collect in our houses even if all the doors and windows are open is owing to another action which has no bearing on the subject in hand.

Now we come to evaporation or the disappearing of the dew. We have the air in two layers, the moist one lying near the earth and the dry one higher up. The sun rising in the sky begins to send its rays of heat earth-ward, the layer of air lying next the earth becomes warmed first, and owing to the principle that warm air rises, it rises and the cooler air comes down to take its place next the earth. The air which is now next the earth is dry or lacking in water vapor, so the lack is made up by absorbing a certain amount of water in a state of vapor from the dew on the plants. This circulation has not continued long before all the dew is evaporated. This process of evaporation in nature does not cease when the dew has disappeared, but goes on continually, because there is always a demand for more water vapor in the air on account of it being partially condensed in the upper regions of the air, thus forming first clouds, and if condensed further the clouds form rain or snow.

We will now proceed to discuss the making of steam in boilers,

and then its change from steam to water vapor, after which we will compare it with the process described above. For purposes of comparison we will turn water into steam in a boiler open to the atmosphere, that is to say, we will raise steam under a pressure of 14.7 lbs. per square inch. In this we are under the same conditions as the dew which was turned into vapor under atmospheric pressure also. We will suppose that the boiler which we are going to use is a small, circular vessel say 6" in diameter and 12" deep, which may be set over a stove hole and supplied with a steam tight cover somewhat like a piston, by using which we may vary the pressure. We will now put some water in the boiler, and place it over the fire, the cover being left off. Now, remembering that water is made up of particles held together by a force (in this case 14.7 lbs. per square inch, or whatever the barometer may read), which must be overcome before we can have steam, we are called upon to exert a force in opposition to the force holding the particles together. We do this by lighting a fire under the boiler. As the fire burns, a certain amount of the energy of the coal is transferred to the water, causing its temperature to rise until when it has reached about 212° F. the coal has transferred enough of its energy to the water to enable it to overcome the atmospheric pressure; and water pressure and steam is given off. Now we have water in a state of steam which is visible to the eye. If we watch the cloud of steam as it rises upward it will be noticed that it gradually gets thinner and thinner until at last it disappears from view.

What has become of it? We have produced the invisible water vapor and it has been absorbed by the air.

The change from steam to vapor took place like this: In a boiler it is the water which lies next the surface exposed to the fire that is first turned into steam. In order to do this the coal must transfer enough energy to the water to raise not only the atmospheric pressure, but also the pressure due to the depth of water in the boiler. Now, when the particles of steam emerge from the surface of the water they are under a less pressure than when at bottom of the boiler, and so contain more heat than is necessary to keep them as steam. This surplus heat or energy causes an expansion or bursting of steam into the smaller particles which constitute water vapor, which is absorbed by the atmosphere. This last expansion is on the same principle as when we open a try cock below the water line on a working boiler—it is not water that blows out, but steam or vapor.

We will now sum up these two operations. In the first, the heat or energy of the sun does work on the atmosphere, thus setting the air in circulation, and as a result of the air circulating water is absorbed. In the second, the heat or energy of the coal does work on the atmosphere, setting free the steam and at the same time storing in the particles of steam an energy which turns the steam into vapor when it rises into the air.

From the above conclusions we see that evaporation, or nature's method of making water vapor, and the making of steam at atmospheric pressure and its change into vapor, differ only in the two forces that produce them.

In reference to making steam in boilers there are two interesting cases besides the one which we have just discussed, namely, making steam under a pressure greater than the atmospheric pressure, and under a pressure less than the atmospheric pressure. Dealing with the first mentioned case, that is, where the pressure is greater than the atmospheric pressure: This condition can be brought about by fitting the steam tight cover on the boiler mentioned in the first case and putting some weights on it to the amount of 5 lbs. per square inch. Now, instead of steam being given off when the water is at about 212° F., it will not be given off before the temperature is 226° F. This increase in temperature is due to the fact that before steam can form in this case the coal must transmit to the water enough of its energy to raise 19.7 lbs. per square inch, instead of 14.7, as before. This condition of things comes about naturally when boiling water in mines, for as we descend into the earth the atmospheric pressure increases, which corresponds to the added weights.

Lastly and briefly, we will consider the making of steam under a pressure less than the atmosphere at sea level. For this we would have to exhaust the air from our boiler by an air pump or other means. Then we would find that steam would be given off when the water is at a temperature less than 212° F. according to the amount by which the pressure in the boiler is less than atmospheric pressure. This shows that as there is less pressure keeping the parts together in this case than in the other two it therefore requires less energy to set the steam free. As an example of this in nature, it has been noticed by travellers going up mountains that when they get high up it takes a much longer time to boil eggs than on the plain below, although the water in giving off steam went through the same action in both places. This was due to the fact that at the top of the mountain the pressure of the atmosphere was less than at the bottom, and the water though giving off steam did not contain the heat necessary to boil the eggs. I think if these travellers had been engineers they would have piled some stones on the lid of their kettle in order to save time. In this case it is interesting to notice that although it requires less heat to raise steam at a high elevation than at the ordinary atmospheric pressure at the sea level, we do not gain anything by reducing the pressure, because when we sum up the heat required to raise the steam and the force required to reduce the pressure below the atmosphere we will find that it will amount to the same thing as if we were making steam at atmospheric pressure.

The above paper was greatly appreciated by the engineers, as was also a paper by Mr. Charles Moseley,

chief engineer of the Toronto Incandescent Light Company, which is also printed herewith :

ECONOMY IN THE BOILER ROOM.

By CHAS. MOSELEY.

THE fuel expense is one of the largest in the operation of the majority of plants, and any reduction which can be made in the amount of fuel used, while maintaining the same amount of power, is considered a direct gain. The evaporation of more than nine pounds of water per pound of coal is looked upon with suspicion by many, as it is thought impossible to obtain more than this amount in even the best designed and well regulated furnaces and boilers, especially when the firing is done by hand. Mechanically fed boiler furnaces usually give the most economical results. The actual value of the fuel depends upon the way in which it is used fully as much as on any other factor. The heat unit in the coal should be as much as possible utilized. In one pound of good steam coal there is about 14,000 B.T.U., and about 10,000 of this amount can be utilized, so that 4,000 heat units are lost.

The mixture of gases in a furnace depends on the amount of air used. One pound of coal requires, theoretically, about twelve pounds of air to burn completely, but in practice about twice this amount is required in the boiler furnace. To cause good combustion, coal requires a good draft; the gases are consumed near the fire and the waste gases carry the heat to the boiler on their way to the stack. The boiler ought to have sufficient heating surface, or the hot wasted gases ought to travel a sufficient distance to be cooled down to about 350° F., which temperature is found high enough to produce a good draft in a stack at least 100 feet high. It is not necessary for me to state the need of keeping the combustion chambers free from the ash that is carried over with the gases to the chambers.

In "Smokeless Heat," published by the General Engineering Company, there is a paragraph entitled, "Competitive vs. Ordinary Test," which is well worth consideration, and I think we might study it with profit. In nearly all plants where a large quantity of coal is burned per day, it is a general rule to employ the least possible number of firemen, and it keeps them very busy going from one boiler to another shovelling coal in the whole time. It becomes more of the nature of slavery than anything else. Is there economy in this way of working? Let us see.

In making evaporation tests my experience has been that there is a large difference between ordinary working and working for short spells, as in making competitive tests. When we were making tests in our plant while experimenting with shaking grates, the Hawley Down Draft and the Jones Underfeed, we did so in many different ways. With the Hawley Down Draft in one particular case we fired the boiler as we would in ordinary practice, and the result was certainly a far different one from that obtained when the man stood by the furnace and attended to it alone. If we treat the fireman as being naturally lazy, I think we will be on the safe side, and you can rest assured that if he has one boiler that will do the same work as another with half the labor, even though the other takes less coal, this boiler will get the most work, and the boiler that should receive constant attention will get very little consideration from him. Between competitive and ordinary working on a hand fired boiler there is actually a difference of 10 per cent. This I have proved repeatedly, and in many cases it has run up as high as 12 per cent. What does this mean? Does it mean that it would pay to have a man at each boiler and simply attend to it alone? No, it does not, for the simple reason that the less a man has to do, the less he is inclined to do, and this applies more to firemen than to anyone else.

I might state that when we were testing the Jones stoker we had long periods when we had competitive tests, and others again when we ran as in ordinary practice, that is to say, the fireman doing just precisely as he would do if no test was being made. The coal and water, however, were measured in each case. The results were simply astonishing. In the ordinary running test the Jones stoker would do about 50 per cent. more work and nearly 25 per cent. better economy, whereas in the competitive test the work done on the stoker was about 25 per cent. more and 15 per cent. increased economy, which bears out the statement that between competitive and ordinary running we have a difference of 10 per cent. Now, which is the correct way to look at this matter? Can we obtain results right along with hand firing equivalent to those obtained during a competitive test. I do not think so, because firemen as a rule do not like to be beaten, and will do their very best during a competitive test to do up the other fellow, but at the same time he is wishing inwardly that the test was over, so as to get back to the old style again.

There are many plants in Canada where very good results are obtained, if we take the results as shown by engineers into consideration, several of them showing a usual 14 lbs. evaporation per pound of coal. This, you will readily understand, is out of the question. There are also a large number where very poor results are obtained, and these poor results are due to several causes, namely: Boilers in very bad order, dirty tubes, poor setting, poor boilers, poor firemen, etc. The men who sell boiler compounds will in all probability say that you do not use enough of their compounds. Your answer to that is, of course, that there are compounds on the market that are absolutely of no use whatever, and it is simply throwing money away to buy it. I myself believe in a good compound, but will admit that it is difficult to get it. You may get one barrel (the first from a new maker) fairly good, the second of no use whatever, and so it goes. A good compound is required, and to my mind to-day we have not such a thing. All compound makers ask you in their advertisements to send on a sample of your water and they will give you the very compound you require after analysis. You, of course, know what this means—that if one brand does not work they will send another brand, of practically the same material, with another name, and you try it.

Poor boilers and poor setting: This is attributed to trying to keep down the first cost. Pay a good figure for a good boiler, and have it set by competent men.

Poor firemen: This, in my humble judgment is the most important item, and one that should receive much consideration. The fireman may not be poor, but the work he has to attend to—namely, firing too many boilers—makes him feel that he is

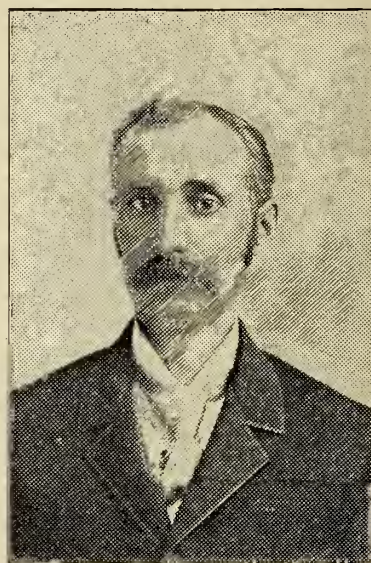
nothing more or less than a laborer, and as long as he keeps the steam pressure up, no matter how much coal he burns or how he does it, there appears to be little or no attention paid to him. There are many places where the fireman is never thought of except when the steam pressure goes down, and when such is the case the usual deputation calls upon him to ascertain if he is asleep or not. A good fireman is really a skilled workman, and should be treated as such. He should receive a fair salary, and his employer should bear in mind that any reduction in his pay is far from being a saving. If he is cut down \$2 per week, you will in all probability find your coal bill increased about \$8, and there is not much economy there.

How are we to obtain better results in our boiler rooms? I think by putting in machines to do the work, and having men simply to look after them.

THIRD DAY.

Upon reassembling on Wednesday morning, the report of the Mileage Committee was presented and adopted. This fixed the total expense of travelling, etc., at \$179.

Mr. W. F. Chapman reported on behalf of the committee appointed to interview the members of the Dominion government with a view of having a Stationary Engineers' License Bill passed. The Minister of Justice had stated that it was out of the jurisdiction of the Dominion government, and would have to be taken before the Provincial legislature. A new committee, consisting of Messrs. Dixon, Allan, Webb, McNaughton and Pettigrew, was appointed to take such further steps as might be deemed advisable. It was felt that a bill



MR. W. F. CHAPMAN,
President Canadian Association Stationary Engineers.

somewhat analagous to the Marine Engineers' bill would be satisfactory.

The Committee on the Good of the Order presented its report. It recommended that more consideration be given to educational matters.

A committee, consisting of Messrs. Ryan, Robertson and Dixon, was appointed to arrange for the publication of the Association Bulletin and reports.

In the afternoon the election of officers was proceeded with, the result being as follows: W. F. Chapman, Brockville, president; R. C. Pettigrew, Hamilton, vice-president; J. G. Robertson, Montreal, secretary; G. C. Mooring, Toronto, treasurer; William Bear, Dresden, conductor; John Wendell, Waterloo, doorkeeper.

It was decided to change the name of Toronto Branch No. 2 to No. 18, as the Hamilton Branch is known as No. 2. Berlin was selected as the meeting place for the next convention. Past-presidents' jewels were presented to Messrs. E. J. Phillip, of Toronto, and Thomas Ryan, of Montreal.

Through the courtesy of the Hamilton Street Railway Company, the delegates enjoyed a trip around the city in special cars. Invitations were accepted to visit the Museum and the Gurney-Tilden Company's works.

THE BANQUET.

On Wednesday evening the usual dinner, tendered by the local association, took place at the Waldorf Hotel. The president's chair was occupied by Mr.

Robert Mackie, and the vice-chair by Mr. Thomas Chubb. Toasts were responded to by the following: "Canada, Our Home," by Stuart Livingston; "Mayor and Corporation," by Ald. Nelligan and ex-Mayor Blaicher; "Manufacturers," by ex-Ald. A. H. McKeown; "Educational Interests," by Inspector Ballard, J. S. Williams and Percy Domville; "The Executive Head," by president W. F. Chapman, ex-president E.



MR. R. C. PETTIGREW,
Vice-President Canadian Association Stationary Engineers.

J. Philip, and Joseph Robinson; "Sister Associations," by A. M. Wickens and John Field; "Press," by E. B. Biggar. Songs were contributed by Messrs. James Jardine, George Allan, E. T. Martin, W. W. Barlow and W. G. Grant. The committee in charge of the banquet arrangements consisted of Messrs. Robert Mackie, chairman; J. Ironsides, secretary; W. R. Cornish, W. Stevens, R. E. Chilman, Thomas Chubb and George Mackie. It was conceded by all that the banquet was a complete success in every respect.

MOONLIGHT SCHEDULE FOR OCTOBER.

Day of Month.	Light.	Extinguish.	No. of Hours.
	H.M.	H.M.	H.M.
1....	No Light.	No Light.	.....
2....	P.M. 6.00	P.M. 8.30	2.30
3....	" 6.00	" 8.30	2.30
4....	" 6.00	" 9.20	3.20
5....	" 6.00	" 10.00	4.00
6....	" 6.00	" 11.00	5.00
7....	" 6.00	" 11.50	5.50
8....	" 6.00	A.M. 12.50	6.50
9....	" 6.00	" 2.00	8.00
10....	" 6.00	" 3.00	9.00
11....	" 6.00	" 4.10	10.10
12....	" 6.00	" 5.10	11.10
13....	" 6.00	" 5.10	11.10
14....	" 6.00	" 5.10	11.10
15....	" 6.00	" 5.10	11.10
16....	" 6.00	" 5.20	11.20
17....	" 6.00	" 5.20	11.20
18....	" 6.20	" 5.20	11.00
19....	" 7.20	" 5.20	10.00
20....	" 8.30	" 5.20	8.50
21....	" 9.30	" 5.20	7.50
22....	" 10.50	" 5.20	6.30
23....	" 11.00	" 5.20	6.20
24....	.....	" 5.30	5.20
25....	A.M. 12.10	.....	.....
26....	" 2.10	" 5.30	3.20
27....	No Light.	No Light.	.....
28....	No Light.	No Light.	.....
29....	No Light.	No Light.	.....
30....	P.M. 5.30	P.M. 8.30	3.00
31....	" 5.30	" 8.30	3.00

Total..... 189.40

When we have tight and loose pulleys and a belt to ship we naturally put the belt shipper as near the driven pulleys on the countershaft as possible. There are many mechanics who have never thought of putting the shipper anywhere else and who probably could only with difficulty be persuaded to do so. As a matter of fact there are many cases in which, where the tight and loose pulleys are of the same diameter, with straight faces, and where very quick and frequent shipping of the belt is not required, it is much better to place the shipper near the driving pulley on the lineshaft, to operate on the belt as it approaches that pulley.—American Machinist.

MR. CHARLES MOSELEY.

MANY engineers and readers of this journal will recognize in the accompanying portrait the countenance of Mr. Charles Moseley, President of Toronto No. 1, C.A. S.E., and chief engineer of the Toronto Incandescent Light Company on Terauley street. Mr. Moseley was born at Chart, Sutton, County of Kent, England, in the year 1860. At the early age of eleven years he commenced his mechanical education in the machine shop of Steaven, Hooker & Co., who were so impressed by the thoroughness of his work, and his evident ability, that they gave him full charge of their steam plant and repair shop, although at that time he was but 16 years of age. He remained with Messrs. Steaven, Hooker & Co. for over ten years. In 1884 he left his native land and sailed for Canada. Arriving in Toronto, he secured a position with Mr. John Fletcher, a well-known builder and contractor, as engineer; all the machinery on the premises being under his control. He remained with Mr. Fletcher for six years, leaving to accept a position with the Mail Publishing Co., Toronto, but after six months returned to his former employer, for whom he worked one year.

Later Mr. Moseley secured the position of engineer of the North Toronto Electric Light and Waterworks, and in August, 1893, he accepted his present responsible position as chief engineer of the Incandescent Electric Light Co., on Terauley street. The plant under his charge is one of the most efficient in the city. There are two Babcock & Wilcox boilers of 225 horse power each, fitted with two Jones stokers under each boiler, and six tubular boilers of 125 h.p. each. The engine capacity consists of one vertical compound of 600 h.p., three Armington & Sims of 200 h.p. each, and two straight lines; while two 200 kilowatt direct acting



MR. CHARLES MOSELEY,

dynamos, four 100 k.w. and four 60 k.w. machines, comprise the electrical equipment.

Mr. Moseley has always taken an active interest in the Canadian Association of Stationary Engineers, and in July last was elected president of the Toronto Association. A paper from his pen on "Economy in the Boiler Room," read at the recent annual convention of the association, will be found on another page.

QUESTIONS AND ANSWERS.

"C. B.," Kingston, Ont., writes: "Kindly inform me if mica can be reduced to an oil and by what substance. Will it form an alloy such as silver? Will mica retain its original properties when in liquid form?"

ANSWER.—Mica occurs in various forms, chiefly as tri-silicate of the alkaline earth metals, usually magnesium and potassium, and cannot be reduced to an oil retaining its physical properties or elementary chemical composition. No doubt the elements composing mica could be combined with other minerals to form an alloy, but would have no particular value.

COMPRESSED PEAT AS FUEL.

In every manufacturing establishment where power is generated by means of steam, the cost of fuel is one of the largest items of expense. The possibility of securing some fuel cheaper than coal has been investigated by scientists in earlier years, but little has been accomplished that would lead them even to anticipate success. It is natural, therefore, that widespread interest is manifested in the present and prospective operations of the Canadian Peat Fuel Company, which has for its object the utilization, for the purposes of fuel, of the immense peat bogs to be found in Canada. That this particular class of fuel is destined to supersede coal may be a question in doubt, yet we believe the progress that has been made by the above-named company, and the results attained by experiments, are sufficient to warrant some reference to the subject in this journal. It is a question in which central station managers, and steam users in general, are interested.

That peat has been used as fuel in European countries for many years is well known. The method of converting it to the desired form for burning has consisted in reducing the peat to a paste by the addition of water, and then pressing the wet peat into the form of briquettes, and drying these blocks in the open air or in a kiln. Some scientists have aimed at the reduction of

atmosphere. It is then ready for manufacture, and the next step is the reduction or disintegration of the dried mass until it assumes a pulverized character. This is accomplished by means of a breaker, which revolves at a high rate of speed, and breaks the material to powder with iron teeth. The fibre, however, is preserved free from any undue fracture, and without liberating any of the indigenous or inherent combustible matters. From the breaker an exhaust fan draws the powder into a large hopper, from which it descends to the machine, where it is stamped into cylinders two inches wide, and of the same depth. The peat is here reduced by pressure to cylindrical blocks of about two inches in a tube without bottom, the resistance to the enormous pressure of some thirty tons being entirely obtained by the friction of the material against the side of the tube. The reduction of bulk from the raw material to the finished block is in the proportion of 6 to 1. The product ready for burning takes the form of a block about 3 inches in length and 2 inches in diameter, very hard and dense, and containing all the fibrous, carbonaceous, volatile and other materials and elements which are originally embodied in raw peat, and an amount of moisture only corresponding approximately with that in the surrounding atmosphere. The patent vertical press, built of cast steel, the invention of Mr. Dickson, with a moder-



PEAT BOG AT WELLAND, ONT., SHOWING BUILDINGS OF CANADIAN PEAT FUEL COMPANY.

the moisture by different applications of artificial heat, and endeavored to increase the output of the manufactured material by various mechanical arrangements. The objection to the above methods is that peat cannot properly be consolidated while it is wet. With a full recognition of these facts, and after much experimental work, Mr. A. A. Dickson, of Toronto, has discovered a method which would seem to entirely solve the problem of utilizing the product of peat bogs as fuel. Mr. Dickson has investigated very extensive tracts of peat bog in Canada, and has obtained a patent on a valuable machine for the conversion of the crude material into compressed peat. The Canadian Peat Fuel Company, in which he holds a controlling interest, and which is capitalized at \$1,500,000, have in operation a plant at Welland, Ont., where they own a peat bog of some 5,000 acres in extent.

The origin of peat bogs is so well understood as to require little explanation. They occur in low situations, or where some natural or artificial obstacle impedes the drainage, and extend sometimes to a depth of ten feet. By virtue of their immense stores of carbon, they constitute a potential source of fuel supply.

The process of manufacture, as at present employed at the company's works near Welland, consists, first, of the excavation and drainage of the peat at the bog and its natural drying in the open air, until the material retains only approximately the same humidity as the

ate expenditure of driving power and only two formers or dies, working against a yielding resistance, has an output of about $1\frac{1}{2}$ tons of pressed peat per hour, but it is proposed to build machines of much greater capacity at an early date. The gear type of compressing machine now in operation is run by a small engine, but ere long a new type of press, carrying its own steam cylinders, running at a much higher rate of speed and producing fully twice the quantity of fuel per hour, will be adopted.

One gear machine is in operation at the Toronto Industrial Exhibition now in progress, and a personal inspection convinced the writer of the wonderful results being accomplished. The furnace firing the boiler was fueled by the compressed peat, and a particularly bright and strong fire was observable. The fuel is said to be non-friable and weatherproof by reason of its solidity and the external glaze imparted to it by frictional contact with the forming dies. The inherent moisture of the peat is reduced to 12 per cent. The weight of the fuel is given as 83 pounds per cubic foot, while bituminous coal weighs 73 pounds and anthracite coal 93 pounds per cubic foot. Other qualities of this fuel are claimed to be freedom from sulphur, and that it makes neither smoke, soot, dust nor clinkers during consumption.

Experimental tests have been made, the results of which show that the fuel bids fair to become a strong

competitor with coal. On December 28th, 1897, a test was made at the power house of the Metropolitan Street Railway Company, North Toronto. It occupied twelve hours, and was made in competition with a first-class quality of coal. For the information of our readers, we give below the actual results as submitted by Mr. James Milne, electrical engineer :

	Coal.	Peat.
Duration of test in hours.....	12	7
Average E.H.P.....	42	46
Average I.H.P.....	60.8	65
Total fuel burned in lbs.....	4,195	2 984
Average steam pressure.....	88	90
Average feed water temperature.....	102 deg. Fah.	50 deg. Fah.
Hourly fuel consumption in lbs.....	349.6	426.3
Fuel per E.H.P. hour in lbs. observed..	8.32	9.267
Fuel per I.H.P. hour in lbs. observed..	5.768	6.558
Total ash in lbs.....	250	68
Percentage of ash.....	6 p.c.	2.28 p.c.
Relative value of fuels as per indicator diagrams (actual conditions).....	100	86.3
Relative value of fuels per indicator diagrams, taking difference in feed water temperature and steam pressure into account.....	100	90
Relative value of fuels as per ammeter readings (actual conditions).....	100	88.6
Relative value of fuels as per ammeter readings, taking difference in feed water temperature and steam pressure into account.....	100	92.3
Mean of No. 14 and No. 16.....	100	91.15

Had grate bars been arranged to suit the new fuel, it is claimed that very much better results could have been attained.

A few weeks ago a test was made on the steamer Primrose, of the Toronto Ferry Company, and the certificate of the chief engineer states that for quick steaming this fuel proved superior to coal, quantity consumed was not greater, smoke was not visible at any time, and ash was very much less. The report of the fireman running one of the Sawyer-Massey Company's portable engines at the Toronto Exhibition says: "For quick steaming I never used fuel to equal peat. It is quite as economical as coal, and in many respects greatly superior. It is smokeless, cleanly to handle, very little ash, and no sulphurous gas, consequently makes no soot to gather on the tubes. I find the stoking much easier than with coal. I banked the fire at 5:30 p.m., closing off the drafts, and found plenty of fire next morning at 7 a.m., with 60 lbs. of steam up. When the fire has burned out I find the grate bars perfectly clean."

It is contended that the cost of production is no greater than that of mining coal, while there will be a great saving in freight owing to the close proximity of the peat beds. As tracts of peat bog are to be found in nearly every part of Canada, it is the intention of the Canadian Peat Fuel Company, who control patents for Canada, to dispose of county rights. In fact, some of these have already been sold. In this way it is believed that electric lighting stations will be enabled to obtain compressed peat cheaper than slack coal, which is now used almost exclusively. Although the development of the industry has only commenced, it is reported that local companies who have secured patent rights are making quotations of \$3 per ton net at the works, and it is believed that it will be possible to lower this figure considerably.

The Parry Sound Electric Light Company have, owing to increase of business, found it necessary to increase their capacity, and have closed a contract with Mr. Charles Barber, of Meaford, for a pair of 42 inch horizontal water wheels.

Later reports show that the damage to the works of the Jenckes Machine Co., at Sherbrooke, Que., by fire on the night of the 13th of August, was very much exaggerated. The fire was confined to the machine shop building, and the other departments, foundry, boiler shops, etc., were in operation as usual on the following Monday. A few days later a portion of the machine shop was started up, and the whole was in running order by the 23rd of August. The patterns, drawings and office records were preserved practically intact, and all orders for work are being accepted as usual. The principal item requiring replacement is the roof of the machine shop; this, however, is well under way. The whole of the work is being pushed with much energy, and the numerous orders in hand will suffer comparatively slight delay.

SPECIFICATIONS FOR ELECTRIC PLANT FOR CITY OF LONDON, ONT.

TENDERS were recently invited by the city of London, Ont., for the supply of an arc lighting and steam plant, upon specifications prepared by the City Engineer. At the council meeting held for the purpose of considering the tenders submitted, a letter was read from a company engaged in the manufacture of electrical apparatus, contending that the specifications were so worded as to exclude many manufacturers from tendering. We publish herewith a copy of the specifications for the arc lighting plant, and invite electrical machinery manufacturers and engineers to express their opinions as to the adaptability of the same, with a view of learning how far they meet with general approval. The specifications were, of course, prefaced by the usual instructions regarding the carrying out of the work.

SPECIFICATIONS FOR ARC PLANT.

DYNAMOS.—The contractor shall furnish and install the following dynamos, apparatus and material: Four (4) arc light dynamos, direct current, each having a capacity of 100 and to have a guaranteed efficiency of not less than 86%, 2000 candle power, 9.6 ampere, 45 volt arc lamps. Each dynamo shall be provided with an automatic regulator, which shall automatically make the proper adjustments for all changes of load from no load to full load, the adjustments to be made in such a way as not to endanger any part of the dynamo, appliances or lamps, nor to cause any perceptible change in the balance remaining in operation. These dynamos shall be of the..... system and of the latest and most efficient pattern, mounted on a base provided with an adjustable belt tightener, so that the belt may be tightened while in operation, and capable of operating at full load for fifteen consecutive hours without increasing the temperature of any part, especially the armature, fields and commutator not to exceed 70 degrees over surrounding atmosphere or to such a degree as to endanger the insulation or decrease the efficiency of operation; shall have an insulation resistance of not less than 250,000 ohms between all parts insulated from each other; shall be adapted to operate at a speed not exceeding 900 revolutions per minute at full rated load, including 84 miles of circuit wire; shall be provided with efficient self-oiling bearings, having flexible bearings of the ball pattern and equipped with sight glasses so as to determine at all times the level of the oil in the reservoir. The armatures shall be balanced both electrically and mechanically, so that there will be no tendency to strain the shaft or to draw the armature towards either bearing so as to cause any excessive friction and heating, and no vibration. Special pains shall be taken with the insulation, protection and separation of contacts, binding posts and bare surfaces having extreme differences of potential in order to minimize the danger of accidental shocks, crosses or grounds under normal conditions of operation. The dynamos shall be so designed and automatically regulated that the power will be automatically proportioned to the number of lamps burning at any time. On each dynamo is to be placed one switch for short-circuiting the armature. Each dynamo is to be equipped with a pulley of properly proportioned dimensions and having the proper width, face and diameter to successfully transmit the necessary power to operate them at their rated speed under all conditions of load. Each dynamo is to be equipped with a spare sets of brushes, and if removable segments are used, to have also a spare set of segments. These dynamos are to be placed in the lighting station in London on suitable foundations which will be furnished by the purchaser. There shall be provided with each dynamo in addition to the automatic regulator referred to above, one controller for standardizing the current and making it constant at all times under all variations of load, and also one ampere metre for indicating the current supplied by the dynamo, said ampere metre to be properly calibrated; also one main switch and two efficient lightning arresters of the..... pattern. Supply all necessary double belting required, of first-class material.

GUARANTEE OF DYNAMOS.—The contractor will guarantee each dynamo furnished to be fit for operating daily, for 18 hours of a continuous run at its rated output, or any less output; to be free from defective material, and to withstand without injury the sudden breaking of the circuit when running at full load, or a sudden short circuit of the lamp circuit, said short circuit to remain on for five minutes without any attention being given to the machine. He will undertake to replace, free of charge, each armature or field coil which may burn out, or otherwise become defective in any manner, or from any cause, within one year after the acceptance of same, unless it shall be proved to the engineer without question that the defect was due to the fault of the city's employees.

TESTING INSTRUMENTS.—With the above four (4) dynamos is to be furnished one portable ammeter, Weston make, having a scale from zero to 20 amperes, the same to be dead beat, direct reading, and capable of being left in the current all the time, without damage or altering of the calibration. Also one volt metre, Weston make, scale 10 volts to 75 volts; both these are to be portable, so that the current can be read from any part of the city. Also two testing magnetos, capable of ringing through 50,000 ohms, are to be supplied with the entire plant.

ARC LAMPS.—There shall be provided 350 Adams-Bagnell arc lamps of 2000 nominal candle power, the same to be single carbon, having carbon holders of the proper size to hold 7/16 to 5/8 carbon. Each lamp will be provided with a switch by which it may be cut in or out of circuit; shall be regular in its feeding action; shall be free from hissing, flickering or flaming when provided with ordinary commercial standard carbons; shall have no complicated clock-work mechanism; shall contain an efficient device which shall automatically cut out a lamp for any reason defective, without interfering with the operation of the remaining lamps in circuit; shall be simple, strong and durable in its mechanical

construction, and must be thoroughly protected with a weather-proof hood of an approved design, and provided with an absolute cut-off.

LAMP GUARANTEE.—The contractor will guarantee each lamp furnished by him to be free from all defective material, and perfect in workmanship, and to be in all respects in accordance with the specifications and with the statement made by him in writing in his bid. Said insulation of lamps to be able to withstand the difference of potential of 5000 volts, if so required. No lamp will be accepted until it has been run on the circuits for a period of 90 days; if any defect should show during the period, the lamp or lamps to be replaced for new ones by the contractor.

HANGERS.—The contractor shall furnish 200 lamp hangers of a suitable design, which are to be placed on the poles extending therefrom not less than nine feet, the same to be so arranged as to permit of easy access to the lamps for the purpose of trimming same or repairing.

HANGING EQUIPMENTS.—The contractor shall also furnish 350 complete equipments, consisting of pulleys, cable $\frac{3}{8}$ Manila rope, reels, etc., necessary for the erecting of 350 lamps in the centre of the streets between the poles. The cables to be of iron flexible wire of sufficient strength to safely carry the weight of the complete lamps, as well as the pulleys, etc. The pulleys shall be of the latest approved safety pattern, so that in the event of a rope breaking, the lamp will not fall to the ground. These equipments are to allow for lowering the lamps to the ground for the purposes of testing or trimming.

GLOBES.—The contractor shall furnish 350 clear glass globes, the same to be not less than 12 inches high and 11 inches diameter.

CARBONS.—The contractor shall furnish all necessary carbons to start the plant.

SWITCH-BOARD APPARATUS AND CONNECTIONS.—The contractor must furnish and erect in the lighting station one marble switch-board of an approved design, with a capacity for 12 circuits and 12 dynamos, and provided with the necessary sockets, plugs, main and transfer cables, testing connections and a suitable and convenient device for holding cables when not in use. It shall be so arranged and marked that any circuit or series of circuits may be quickly connected with or disconnected from any dynamo with the least possible danger of short circuits or error. Sockets shall be so designed that it is practically impossible to short circuit, ground, or receive a shock from them. All connections shall be easily accessible, and made at back of switch-board. All wires used in making connections must be flexible, and have a carrying capacity of not less than 40,000 circular mills, and must be composed of 30 or more strands, to be thoroughly insulated and covered outside of the insulation with flexible rubber tube. All connections must be made in such a way as to ensure good and sufficient contact to prevent heating and ensure permanency. Connecting wires shall be so arranged and secured that crosses or ground are impossible in the normal operation of the plant.

ABSOLUTE CUT-OUTS.—The contractor shall also furnish 50 absolute cut-outs, which are to be placed in locations as laid out by the city engineer, for the purpose of absolutely cutting off any portion of loop of a circuit that may be necessary. These cut-outs are to be thoroughly protected from the weather and inclosed in suitable iron boxes with glass fronts.

INSTALLATION.—The contractor shall place all the above mentioned dynamos, station apparatus and switch-board in suitable locations in the lighting station at London, and furnish all the necessary wire, to be No. 4 stranded rubber covered, gauge and properly run with porcelain knobs to the different outlets in the cupola of the building, furnishing all the necessary material and leaving the dynamos and station apparatus so that the outside circuits can be connected thereto, the belts placed from the power and ready for operation.

DESIGNS.—The contractor must accompany his tender with designs of his dynamos, lamps, hangers, station apparatus, switchboard, cut-outs, etc., and furnish any other information not enumerated herein.

LINE CONSTRUCTION.—The poles must be straight, select and shave pointed cedar poles, sound and free from knots, and shall be not less than 6" diameter at the top, and poles subject to extra strain shall be not less than 7" at the top. The poles on Dundas street from Ridout to Wellington, and on Richmond street from G. T. R. to Fullarton street, shall be not less than 70 feet long, clear of the ground, and set at least 6 feet in the ground. The other poles shall be not less than 35 feet clear of the ground, and set 5 feet in the ground. The poles are to have the necessary gains carefully cut so that the cross arms make a snug fit and stand at right angles to the poles. The cross arms shall be of white pine, thoroughly seasoned, sound and free from knots, and painted. These cross arms are to be not less than 60" long and dressed to $3 \times 4\frac{1}{2}$ ", with a slight pitched top, and are to have four or more oak pins in each, fitting closely in the cross arm and nailed in place and braced with two iron braces. Pins on each side of poles where four pins or larger cross arms are to be used must be less than 17" between centres. The contractor is to furnish all the necessary glass insulators of the standard pattern suitable for the wire they are to hold. All poles on which cut-outs or lamps are placed shall be stepped with spikes not less than $\frac{3}{8}$ " square and 9" long, with heads, and to be placed on each side of the pole at distances not exceeding 3 feet apart, making a step at every 18 inches.

WIRE.—The contractor shall furnish all the necessary wire for connecting the lamps in circuits, as shown on the plan. Not more than 50 lamps are to be connected on any one circuit running out of the lighting station, and all outside wire used in this installation shall be not less than No. 6 B & S gauge pure lake copper, having a conductivity of at least 98%. This wire is to be covered with a triple covering of insulating material and braided with two braids, (samples of wire to be submitted with the tenders). Each circuit shall test out, with an insulation resistance, after everything is connected, of not less than 50,000 ohms per mile. All wires shall be so handled as to avoid kinking, and are not to be dragged along the ground, over cross arms or through trees in such a way as to injure insulation, and shall not be allowed to sag unduly between supports, proper allowance being made for contraction and expansion with changes of temperature. All necessary precautions shall be taken in passing through trees, crossing other lines, turning covers, etc. The joints shall be mechanically strong and secure so that no

movements of the two ends relative to each other is possible. All joints must be carefully soldered, the joint being wiped free from any excess of flux, and the solder will be relied on only to give good electrical connection. Each joint is to be thoroughly wrapped after soldering with a good quality of rubber tape. The contractor will be expected to construct all the lines, furnishing all the necessary material and labor and connect the hangers, lamps, cut-outs, place the hoods and globes, trim the lamps and leave everything in first-class running order.

ADDITIONS AND DEDUCTIONS.—While this specification is intended to represent very closely the number of lamps to be installed, yet, as some changes may become necessary during the process of construction, the contractor must mention in his tender a price to be added to or deducted from the contract price for each lamp installed in excess of the number specified, or which shall be cancelled provided such addition or cancellation involves no change in the work already completed and shall be along the line of existing circuits. Each bidder must specify distinctly, on a separate sheet, the exact amount of material he proposes to furnish in carrying out this contract.

GUY WIRES.—The poles subjected to extra strain shall be securely guyed to the satisfaction of the city engineer. The whole of this work is to be done to the entire satisfaction of the city engineer, and the entire installation is also to conform to the rules as laid down by the Board of Fire Underwriters and subject to inspection and the acceptance of an electrical expert, who is to be selected by the city engineer.

TRADE NOTES.

The Electric Co. of Windsor, N. S., has ordered a 100 horse power Robb-Armstrong engine from the Robb Engineering Co.

Mr. Carman O'Dell, of Annapolis, N. S., is increasing his electric lighting plant by the addition of a 50 k.w. "S.K.C." generator.

The Rossland Water & Light Company have purchased from the Canadian General Electric Company two of their standard three phase motors.

The Jacques Cartier Pulp & Paper Co., of Pont Rouge, Que., have arranged to light their new pulp and paper mills by electricity. The order for the plant has been placed with the Royal Electric Co., of Montreal, and is to be installed immediately.

The Canadian General Electric Co., Limited, have placed in stock a large and complete line of transformers of their different types, from which prompt shipments can be made. The C. G. E. Co. also carry a very large and well assorted stock of all lines of electrical supplies ready for shipment on a moment's notice.

The Windsor Electric Light & Power Co., of Windsor, N.S., are enlarging their recently installed electric lighting plant. They are adding one 100 k.w. and one 40 k.w. "S.K.C." generator, with an additional complement of transformers and material. The "S.K.C." apparatus and generators are from the Royal Electric Co., Montreal.

A number of very large annunciators have recently been turned out of the factory of Ness, McLaren & Bate, Montreal, including those for the new Place Viger Hotel, Montreal; Chateau Saguenay, Chicoutimi, and Ladousac Hotel, Ladousac. All these annunciators are equipped with Norway iron gravity drops, manufactured exclusively in Canada by this firm.

A letter from the Newton Appliance Company, of New York, states that they have about 2,000 Flush switches of what is called their No. 1 tact that they offer for sale at a reduced figure. They are similar in every respect to their standard Flush switch, except that that they are three inches deep over all, which is one-half inch deeper than their standard switch. This extra depth was an error in making up the porcelain, and it prohibits their use in the standard iron boxes, in which Flush switches are used in the United States. Some 5,000 of these No. 1 switches were made up, but 3,000 were disposed of—some in Europe and some in Canada. Quotations on these switches may be obtained from their Canadian representatives, Messrs. Munderloh & Co., of Montreal.

The Wm. Sutton Compound Co. of Toronto, Limited, report that since having placed a representative in Montreal they are well pleased with the large volume of business secured from the largest and best steam users in that city and the province of Quebec. As this is a new and permanent field for their agents, the present success is more than gratifying, and they feel assured that they will have before many months the largest boiler compound trade in that district. Their business in all parts of Canada shows a marked improvement, having been 30 per cent. greater during the last six months than in the corresponding months of last year. This they claim is due to the standard quality of the Sutton boiler compound, which never fails when honestly tried. It is used extensively by breweries, steam bakeries, dyers and laundries, without the slightest injury to their products.

We are pleased to bring before the notice of our readers a new departure made by the Electrical Maintenance & Construction Company, of Toronto, who have opened an office at 609 Temple Building, with Mr. P. H. Patriarche as manager. The object of the company is to do all sorts of construction work and maintain electrical apparatus of all descriptions at an agreed rate per annum, the rate of course being governed by the size and condition of the apparatus or machinery to be maintained. This would seem to offer an inducement to manufacturers and others to use electricity to a greater extent in their operations, as in this way they can limit the cost of repairs to a fixed sum per annum. Mr. P. H. Patriarche has been for many years in the employ of the Toronto Electric Light Company, having started at the bottom and worked his way steadily upward. Under his management the company should meet with success.

PATENT RIGHTS.

CONCERNING the methods adopted to obtain patents in Canada, a correspondent writes to the ELECTRICAL NEWS as follows :

When anyone secures a patent, he is generally of the opinion that he has the right to manufacture, sell or otherwise dispose of the article patented. This is without doubt a fallacy, which can readily be seen from the following :

The device may have been patented before—it may have been in use in other countries for over the time limit as set by the Canadian Act respecting patents of invention. It is a well-known fact that some take a pride in openly stating that no matter what patent is granted, they can get another patent through for practically the same thing without infringing on the former patent. What is the result of this second patent ? The result is invariably a law-suit, much to the detriment of the original inventor ; and the burden of proof as a rule lies on the original inventor. Just as soon as any useful article has been put on the market and there is a good demand for this article (take the Auer light for example), you will find that there are certain parties who will set to work and closely examine the patents with a view of ascertaining if they can in any way be overcome, and unless the principle is patented they have great chances of success, owing to the fact that the original inventor may have been a little loose in drawing up his specifications and claims, or may have entrusted same to a second party, who, perhaps, did not realize the great importance of covering certain points ; or the inventor, anxious to secure his patent, may have overlooked some of these important points. The first inventor, and the man to whom credit is justly due for the invention, may have spent a large amount of time and money in perfecting a machine, yet through a small oversight in his claims, a second party is allowed to patent practically the same machine as he invented, and for which the second party has spent neither time nor money, except in examining the patent.

I know of a case in the United States where an inventor sold his patents to a company. In this company there was a certain party who wished to get control, but who could not do so honestly, so he started out with an infringing device. Now, what method did this party adopt ? He searched the patent records until he came across a device that might be construed in a measure to cover the machine he intended to get up. Bear in mind that this party knew no more about this machine before he went into this company than the man in the moon, yet he bought up this old patent and went to work on same, made the infringing device, and was in a measure successful, and will continue until the matter is definitely decided in the United States court.

You will, therefore, understand how things go ; this particular party could not get control of the original company by fair means, so he set to work to make a similar machine, with a hope of being bought up in order to stop competition in this particular device. There is surely some redress. At present, however, the only redress is to take action against the users of infringing devices. It is a very costly action, and it would appear that there is room for some board of commissioners to examine patents before they are granted, and to see if same can be patented, and that they do not infringe on anything that has been previously patented.

Some patent solicitors are very straightforward in this matter, and before setting out to obtain a patent first examine the records to ascertain if the invention is new, etc. This is without doubt the proper course, but the inventor may say that he wants his patent if it is possible to get it, whether same has already been patented or not. The patent solicitor therefore proceeds, and draws up the specifications and claims, knowing full well that this particular patent is of no use whatever. The patent, however, is got through. The article is then put on the market and the war commences. The company or party owning the original invention notifies all users of the infringing device that action will be

taken in the matter. Owing to the fact that it takes such a long time for a matter of this kind to be settled, and until such time as it is settled the party with the so-called infringing device is hurrying around the country taking orders and cutting prices, and making it very hard for the original company, this company, having also been at the expense of doing the missionary work in connection with this particular article, so far as advertising is concerned, cannot afford to sell the article at such a low figure, but in the meantime must come down to the figure of the second party or get out of business.

It is very true that some inventors may claim more than they are justly entitled to under the patent, but this is readily settled according to the Act Respecting Patents. We understand that the German government defends the patents taken out by original inventors, and we think there is room for such a course in this country. Canada is the easiest country in the world in which to obtain patents, for same are granted without any regard whatever to former patents issued.

MARITIME ELECTRICAL ASSOCIATION.

A MEETING of the Executive Committee of the Maritime Electrical Association was held in Halifax on August 16th, at which two new members were elected. Mr. Colpitt presented the report of the local committee on arrangements for the first annual convention. It has been decided to hold the convention in the city of Halifax on Tuesday, September 27th, simultaneous with the Halifax exhibition. Therefore it will be possible for delegates to the convention to obtain cheap railway fares. Two sessions will be held, one at 9.30 a.m., and the other at 3 p.m. Invitations have been received by the executive of the association to visit the plants of the several electrical companies, and it is proposed that there should be an excursion by steamer on the harbor.

At the last meeting of the association, it was decided to furnish reports of all meetings to the CANADIAN ELECTRICAL NEWS for publication.

PERSONAL.

The city council of Toronto have decided to engage Mr. James Milne, E.E., to report as to the number of electric lights required for lighting the new municipal buildings.

Mr. George F. Macdonald, of Ottawa, Ont., was elected vice-president of the International Association of Municipal Engineers at the recent convention of that association.

Mr. James O'Rourke, late engineer of the Long Pointe asylum, sailed from Montreal last month for Great Britain and Switzerland, for the benefit of his health. Mr. O'Rourke will return in November.

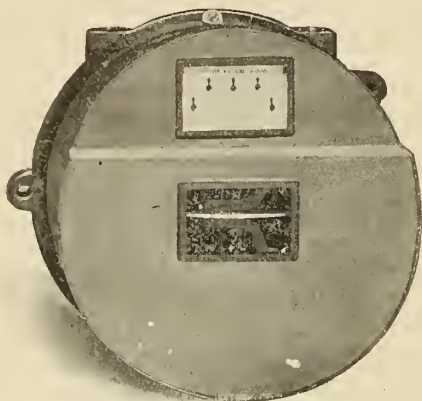
Mr. James Stevenson, who for several years has been employed as electrician by Mr. L. H. Reesor, of St. Marys, Ont., has accepted a position with the Stratford Electric Light Company.

Mr. James W. Woodward, foreman of the wire department at the works of the Canadian General Electric Company, Peterboro', has tendered his resignation, to accept a similar position with the Royal Electric Company at Montreal.

The General Engineering Co. of Ontario advise us that they have installed or are installing the following : Six improved Jones underfeed stokers for the Laurentide Pulp Co., Grand Mere, Que. ; two at the C.P.R., Dalhousie sq. station, Montreal ; one for Rhodes, Curry & Co., Amherst, N.S. ; one for Truro Condensed Milk & Canning Co., Truro, N.S. ; one for Slingsby Mfg. Co., Brantford, Ont. ; twelve for Toronto Street Railway Co. ; one for Windsor Hotel, Montreal, and twelve for the Maritime Sulphite Fibre Co., of Chatham, N. B. The Toronto Railway plant will be one of the most complete of its kind in existence. The coal will be fed by gravity into the hoppers, and the firemen will not handle same at all. The blower plant will consist of two 90 inch steel plate fans, each capable of delivering 22,000 cubic feet of air per minute. These fans are driven direct by electric motors, and the draft automatically controlled. With the improved Jones stokers about 150 cubic feet of air at about $1\frac{1}{2}$ oz. pressure at the tuyeres are required per pound of coal per minute ; therefore it will be seen that with blowers of the above capacity four tons of coal can be burned per hour on the twelve furnaces ; the average burning will be about 2.75 tons. Owing to the magnitude of this boiler plant, viz., 5,000 h.p., a duplicate blower system is being installed, it being realized that electric motors are not infallible. The air piping throughout will be of sheet steel and all joints rivetted. The boilers are of the Scotch marine type. The report of a competitive test made between the improved Jones and hand firing will be sent by the General Engineering Co. on application.

THE NEW SCHEEFFER RECORDING WATT METER.

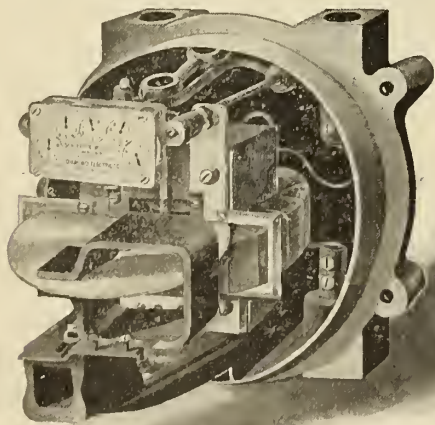
THE Packard Electric Co., Limited, of St. Catharines, Ont., has recently placed upon the market the new Scheeffer watt meter for alternating current, concerning which the manufacturers say: 'This meter has been devised to correct the various faults which exist in other meters to-day. It will be seen by the accompanying



NEW SCHEEFFER WATT METER—WITH CASE.

cuts that the meter is round and has a rubber band placed around the circumference, over which is placed the case. By the use of this rubber band the meter is rendered perfectly air tight and also is made perfectly dust and bug proof. It has been found that meters with cases of ordinary fitting are hampered with dust and dirt, and when such cases are used it is impossible to keep meters correct, even with frequent over-hauling and cleaning. The binding posts of the new Scheeffer meter are insulated in a most thorough manner; no ordinary holes being depended upon. These holes are closed on end, making it impossible that anything can get through the post and also doing away with the necessity of plugging the holes.

The new Scheeffer meter does away with the revolving cylinder, only retaining the revolving disc of aluminum, thereby making the moving parts extremely light, but at the same time not too delicate. The iron circuit in the magnetic system is practically a closed one, preventing stray lines of force from acting on other parts of the meter, and is therefore unaffected by



NEW SCHEEFFER WATT METER—WITHOUT CASE.

outside influences. This closed circuit is said to give the maximum effect with the minimum energy possible in construction, the shunt winding only taking from 1 to $1\frac{1}{3}$ watts on 15,000 alternations, and not exceeding $1\frac{1}{2}$ to $1\frac{3}{4}$ watts on 7,200 alternations.

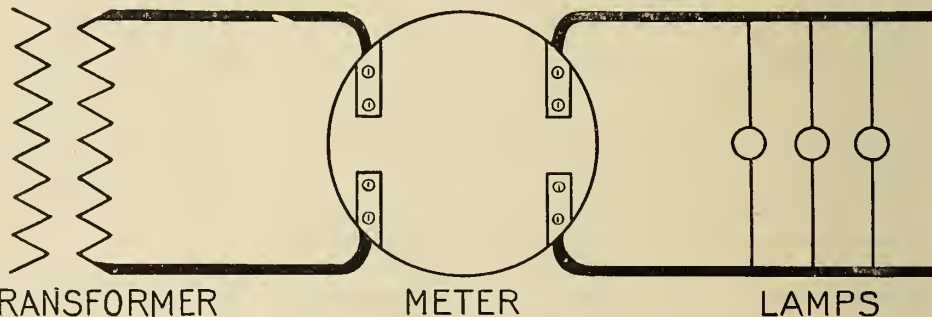
One valuable feature in the new Scheeffer watt meter for central stations to consider is its correctness on inductive loads, and it can therefore be used on fan motors or induction motors, arc lamps, etc. The meter

is extremely compact and requires but a small space for its placing.

It has been found by experience that a central electric lighting station can supply 30 per cent. more customers on the "meter" than on the "flat" rate. This 30 per cent. really represents wastefulness, which is inherent in the nature of the average customer and the "flat" rate. The investment in meters and their proper care make the plant equivalent to 30 per cent. larger. A central station which is in the electric lighting business for the profits on its investment can easily realize the great advantage in the use of meters. That many small villages and cities make but a small profit or the income only sufficient to pay actual running expenses, is not surprising in view of the waste and extravagance of the "flat" rate. These same stations may, by proper and economical use of meters, be made profitable.

It is not necessary to point out the evils of the "flat" rate; but it is self-evident that many customers never take the trouble to turn out all or part of their lamps, and in places where the plant gives all night service the lamps are left burning all night. A fallacy in flat rates is the basing of charges on 50 watt lamps. A 50 watt 16 c.p. lamp is somewhat of a rarity in the market, 60 watt being about an average, and many lamps are used taking more even, 70 or 80 watts. In most small stations the voltage is kept above what the lamps are made for; even in the case of a 50 watt lamp the consumption will be higher. We have found that most small stations if they use 50 volts, keep the voltage at 55 or 60. These wastes are impossible to avoid in the "flat" rate.

A meter measures the actual consumption of current.



CONNECTIONS OF THE NEW SCHEEFFER WATT METER.

The central station gets paid for actual service given the customer, and it behooves the customer to use his lights in the best and most economical way.

A LONG DISTANCE TRANSMISSION.

FRIDAY, the 26th day of August, 1898, will be memorable in the annals of electricity in Canada, being the day on which the Cataract Power Co., of Hamilton, turned the first current on to their long distance transmission line between Decew Falls and Hamilton. The water was let into the fore bays and pipe line at about 3 p.m., and at 3.30 p.m. the hydraulic plant, consisting of two 1500 h.p. water wheels, and the electrical plant of two 1000 k.w. S.K.C. generators, were turned over, the switch closed and the power transmitted to Hamilton, a distance of 35 miles, where it was utilized for lighting arc and incandescent lamps, and also for driving a 40 h.p. S.K.C. induction motor. The incandescent lamps in the sub-station in Hamilton were very artistically arranged in the form of a large star and maple leaf, and were kept lighted until far into the night. It is expected the works will start permanently within a few days.

The Canadian Manufacturers' Association have begun the publication of a Bulletin, to be issued monthly, or oftener, as occasion may require, which will contain the latest and most reliable information regarding the possibilities of the export trade of Canadian manufactures. This information is obtained from the Dominion Department of Trade and Commerce, and from the publications issued by the British and United States governments, and other reliable sources.

SPARKS.

It is the intention of the Peterboro' Light and Power Co. to erect a new power house, at a cost of about \$35,000.

The town of Pembroke, Ont., is securing information as to the advisability of operating an electric light plant under municipal control.

The citizens of Britannia, a suburb of Ottawa, are anxious that the Ottawa Electric Railway Company should extend its road to that place.

The contract for wiring for electric lighting the Victoria Jubilee Hospital at London has been given to the London Electric Company, at the price of \$1,300.

The Canadian General Electric Company are installing a plant for Messrs. A. B. Jardine & Co., of Hespeler, Ont., who have been enlarging their premises very considerably.

"Through the Garden of Canada" is the title of a pamphlet issued by the Hamilton, Grimsby and Beamsville Electric Railway Company, descriptive of the route and scenery of that railway.

The Canada Electric Company, Montreal, have placed an order with the Canadian General Electric Company for one 85 k.w. M. P. direct current generator, to be used at Longue Pointe Asylum.

The fine new dining and sleeping cars recently turned out by the Canadian Pacific Railway Company have been equipped with annunciators manufactured by Ness, McLaren & Bate, of Montreal.

It is worthy of note that the Cork Electric Tramways & Lighting Company, Limited, is the first company in the British Isles supplying electricity for traction and lighting from one central station.

The Canadian General Electric Company have received an order from the Citizens Telephone and Electric Company, Rat Portage, Ont., for one of their standard 2000 light single-phase alternators.

The ratepayers of Perth, Ont., have again defeated the Lanark County electric railway bonus by-law. There is now said to be a scheme on foot to connect Carleton Place and Lanark by an electric road.

The C.P.R. have installed an electric light plant in their new station at McAdam Junction, N.B. The system includes both arc and incandescent light, the company supplying lights for commercial purposes.

The Ottawa Car Company, at its annual meeting last month, declared a dividend of 8 per cent., and decided to increase the capital stock to \$25,000. The demand for cars has necessitated an extension of the works.

The West Kootenay Power & Light Company, Rossland, B.C., are rapidly extending their business, and for a recent extension have ordered from the Canadian General Electric Company three large feeder panels and two transformer panels.

It is contended that the Anglo-American Telegraph Company, which practically holds a monopoly of the telegraph business in Prince Edward Island, is not furnishing a satisfactory service, and if redress is not granted, competition will be invited from other companies.

The announcement is made that the Pacific Cable Company has let a contract for laying a cable from the United States to the Philippine Islands, via Hawaii and Ladrones. It is said that the contract will be completed in six months, and that the cost will be \$10,000,000.

The Hamilton Cotton Co., Hamilton, Ont., have decided to light their mills with electricity, and have placed an order with the Canadian General Electric Company for one of their 40 k.w. direct connected generators, with marble panels.

The ratepayers of Neepawa, Man., have voted to provide \$12,000 to install an electric light system and \$6,000 for a telephone system. The municipal authorities want applications for the position of electrician to take charge of these plants, duties to commence immediately.

A company of Winnipeg capitalists purpose utilizing a portion of the water power on the Winnipeg river. The scheme includes the establishment of an electric railway from the mouth of the Whitemouth river to points on the Winnipeg river, and the transmission of electric power to Winnipeg.

Mr. R. H. Smith, of Tilbury, Ont., whose plant was recently destroyed by fire, has placed an order with the Canadian General Electric Co. for an entirely new plant, consisting of two 15 k.w. standard Edison D.C. dynamos and one 30-light arc machine. Mr. Smith expects to have his plant running again in about two weeks.

Ness, McLaren & Bate, of Montreal, have recently added to the list of goods which they manufacture a new line of electric bells, and are now manufacturing iron box bells and iron frame bells. These they offer in competition with the best on the market, and expect to be able to lower the present prices considerably.

The city council of Toronto, Ont., have accepted the tender of the Sprague Elevator Co., of New York, for the supply of three electric elevators, with plant for five, for the new municipal buildings. The price is \$26,475. The architect states that the electric plant will operate 300 or 400 lights in addition to running the elevators.

Negotiations have been pending for some time for the purchase by an American syndicate of the Niagara Central Railway. It is said to be the intention of the syndicate, which is represented by Mr. Neelon, of St. Catharines, to convert the road into an electric system, and to extend the present line to Port Dalhousie and Beamsville.

The Waterous Engine Works Co., Limited, of Brantford, Ont., are adding to their shop capacity, and are installing a 30 h.p. in-

duction motor from the Royal Electric Co., which is to be operated from the alternating current lines of the Brantford Electric & Operating Co. This makes over 100 h.p. in S.K.C. motors now operating in Brantford.

The Metropolitan Street Railway Company will extend their line as far as Bond's Head, and will erect a new power house at Bond's Lake. It is the intention of the company to dig a canal from the lake to Yonge street, and to have a boat service between the two points. The extension of their road to Schomberg and Newmarket is also under consideration.

Mr. Carman O'Dell, who has been operating the lighting service in Annapolis, N.S., has decided to increase his lighting plant by the addition of a 50 k.w. S.K.C. two-phase generator. He is also adding considerable to his distributing mains, covering a wider area—in fact, nearly doubling the output of the plant. The order for the generator and transformers has been placed with the Royal Electric Co.

A novel and interesting use of the Niagara Falls power is found in a large candy factory at Buffalo, in which all the machinery is operated by electric motors. The chocolate dipping machines, exceedingly ingenious devices, are operated by five horse power electric motors. In another department, a machine which turns out lozenges is driven by a thirty horse power motor.

Mr. J. T. Ayers, of Lachute, Que., has secured a franchise from that town for incandescent electric lighting. For this purpose he has placed an order with the Royal Electric Company for one of their 100 k.w. S.K.C. generators and the necessary transformers and material for the construction of the entire plant. The new plant will be driven by a water power situated about two miles from the centre of the town.

Mr. Herbert Webster, formerly of the firm of Webster & Hicks, Norwich Ont., has secured a franchise for furnishing the town with electric lighting. The Canadian General Electric Company are supplying the entire electrical equipment, which consists of a 700-light single-phase alternator, marble panel switchboard, transformers and wiring. The corporation have contracted with him for the lighting of the streets by forty 32 c.p. incandescent lamps, operated in series.

The Dundas Electric Light Co. have received a franchise from the town of Dundas to furnish incandescent lights throughout the town, and also a contract for the street lighting. Both systems must be in operation by the first of November, 1898. The entire electrical equipment, consisting of a 50 k.w. S.K.C. two-phase generator, with 500 lights capacity in transformers, and all the necessary wire and material, is to be supplied by the Royal Electric Co., and the plant is to be installed at once. Mr. Geo. H. Harper, of Dundas, will be manager of the new company.

Ness, McLaren & Bate, of Montreal, have recently put on the market a new system of office telephones, combining the best features of the magneto system and warehouse battery system, and also using an automatic return switch, dispensing entirely with the service of central exchange or operator. The Montreal Witness building, in Montreal, has been equipped with a complete system of these private interior telephones. The manufacturers claim that the advantages of combining the two systems are apparent to all users of telephone instruments.

Some years ago the Montreal, Park & Island Railway entered into a contract with the town of St. Louis du Mile End, by which they were to supply the town with a first-class electric car service on the leading streets. The company failed to carry out its contract, and the corporation took action against them. The case came up for hearing before Judge Charland, who granted the company a delay of two months in which to carry out its contract. This did not meet with the approval of the Park and Island Company, and the case was taken to the Court of Appeal, where the first judgment was confirmed. Then the company endeavored to take the case to the Privy Council, but their application for appeal was thrown out.

The second general meeting of the British Columbia Electric Railways Company, which is composed of British shareholders, was held in London, England, recently. The president stated that it was again impossible to recommend a dividend on shares, as a large sum of money had been expended in improvements. It was also necessary to ask for a further sum of £100,000, which it was intended to devote towards putting Vancouver in a satisfactory position with regard to electric power. Besides the construction of the Vancouver power house, the improvements of the year included the construction of an entirely new metallic circuit for power business and two small additions to the railway. Mr. R. M. Horne-Payne and Mr. F. S. Barnard were re-elected directors.

Mr. Nelson Moore, of Guelph, Ont., has lately completed a model of an overhead electric railway. The hardwood posts from which the cars are suspended, as well as the base and the arms, are encased in steel and rivetted to prevent vibration. Two iron sockets are suspended from the arms of the post, and into these steel rails are laid. The wheels of the car are built after the manner of bicycle wheels, with steel spokes and ball bearings, which give strength, lightness and ease of motion. The framework of the car will be of strong iron or steel, and the car is suspended from the wheels to a distance of three feet from the ground. The interior is fitted with back-to-back seats, which run the entire length through the middle and are suspended from the top. The inventor claims many advantages for his overhead road. No grading or ground work has to be done in constructing the road; no bridges are required to span streams or cross ditches and ravines. Mr. Moore claims that less power would be required to operate the cars in comparison with the present systems, and that greater speed would be obtained and more effective locomotion secured.

SPARKS.

The Bell Telephone Company have placed a new switchboard in their exchange at Toronto Junction.

The Nova Scotia Telephone Company last month declared the usual half-yearly dividend of 3 per cent.

The town of Cobourg, Ont., invites tenders up to October 31st for lighting the streets of the town. D. H. Mineker is town clerk.

Mr. D. A. Childs has been appointed traffic manager of the British Columbia Electric Railway, to succeed Mr. C. Aird, who resigned recently.

The New Glasgow, N.S., Electric Company, Limited, are said to have deeded their property to secure an issue of debentures amounting to \$30,000.

On August 30th a fire broke out in the power house of the London Electric Company, at London, Ont., damaging the plant to the extent of \$12,000.

Mr. L. E. Whitehead has resigned as superintendent of the Sherbrooke Street Railway, and will be succeeded by Mr. R. R. Smith of Worcester, Mass.

Messrs. Wm. Kennedy & Sons, of Owen Sound, Ont., have just installed a 40-inch Leffel water wheel for the Water, Light & Power Company of Burk's Falls, Ont.

The Bell Telephone Company has notified the Quebec city authorities of its intention to place its cables and wires underground in the central part of the city.

The Metropolitan Street Railway Company are anxious to engage in electric lighting, and are seeking franchises from the municipalities along the route of the railway.

The Fire, Water and Light Committee of the Winnipeg City Council has recommended that an electric wire inspector be appointed, at a salary of \$60 per month.

It is rumored that the management of the Chateau Frontenac Hotel in Quebec contemplates running electric motor carriages to and from the railway stations next spring.

As the result of a disagreement between the Council of the village of Weston and the Toronto Suburban Railway Company, the car service to that village was recently discontinued by the company.

A new telephone company has been established at St. Valier, Que., by which communication is afforded between that place and St. Raphael, St. Cajetan, d'Armagh, and St. Phileon de Bellechasse.

At the works of the Royal Electric Company, Montreal, there is a cable under construction for the purpose of lighting two cotton factories by electricity. This cable will require 32,000 lbs. of copper wire, and will cost over \$8,000.

The Canadian Pacific Railway Co. is building, at its Montreal shops, ten handsome sleeping cars, which will be lighted by electricity, the current being generated by a dynamo operated by connection with the axle, in accordance with the system of the American Electric Lighting Company, New York.

The City Council of Nelson, B. C., has raised the sum of \$40,000 by debentures for the purpose of purchasing the plant and franchise of the Nelson Electric Company. The city now owns both the water and electric light systems. Messrs. J. P. Bliss and James Spwat have been appointed city electricians.

Messrs. Carroll and Smith, representing the Paris Electric and Power Company, have requested permission from the Brantford township council to erect poles and wires along the Paris road for the purpose of supplying the city of Brantford with electric power. It is the purpose of the company to utilize the water power of the Grand River.

The scheme of developing the water power of the Jacques Cartier river at Ste. Catharine, near the city of Quebec, promises to be carried into execution at an early date. A company has been organized, with a capital stock of \$500,000, and Mr. Emerson McMillin as president and Mr. E. W. Cooke, of New York, as manager and vice-president.

The annual meeting of the shareholders of the Parry Sound Electric Light Company, Limited, was held in that town on Tuesday, August 30th. The following directors were elected: W. H. Pratt, president; Thomas S. Walton, vice-president; W. B. W. Armstrong, secretary-treasurer; J. F. Mosley, E. J. Vincent, Rev. W. Evans, and J. R. Stone, M.D.

A by-law to exempt the West Kootenay Power & Light Company from taxation for ten years was defeated by the ratepayers of Rossland, B.C. The company offered in return to supply the city with four arc lights. There is a movement on foot in Rossland in favor of municipal control of the electric light and waterworks systems. The Rossland Light & Power Company asks \$85,000 for its assets, which is regarded by some as excessive.

The city of Victoria, B. C., received tenders as follows for arc lamps: Canadian General Electric Co., \$31.25 each; R. B. McMicking, \$22.50 each for second hand and \$32.25 for new ones; Geo. C. Hinton & Co., \$31.90 for twelve lamps. For wire the tenderers were: Geo. C. Hinton & Co., \$374.95 for 3½ miles; Nicholles & Renouf, \$340; R. B. McMicking, \$392.75; Canadian General Electric Co., \$327.75. The tenders have been referred to the electric light committee for a report.

It is understood that a company is being formed to develop, for electrical purposes, the water power of Chaudiere Falls, near the city of Quebec. It is proposed to light the town of Levis, to pump water for the town from the St. Lawrence, and to supply electric light for the cars of the Intercolonial and other railways at Levis. It is estimated that the falls will give 5,000 horse power. A number of well-known capitalists, including ex-Mayor William Smith, of Montreal, and Mr. Henry Menier, of Anticosti fame, are interested.

The electric light plant at Paris, Ont., was recently damaged by lightning.

The Cataract Power Co., of Hamilton, has placed an order with the Royal Electric Co. for two 250 k.w. and one 180 k.w. "S.K.C." generators.

The town council of Galt, Ont., has passed a resolution that an electrical engineer be engaged to report as to the cost of a municipal electric light plant.

It is probable that the Oshawa electric railway will shortly be extended to Cedardale, where James Robson & Sons have established a large tannery.

The town of Beeton, Ont., has taken tenders for supplying an incandescent electric light plant. Mr. John Galt, C.E., of Toronto, is consulting engineer.

Arrangements are said to have been made for the building of a smelter and refinery at Cranbrook, Ont., and for the installation of a plant for generating electricity.

The statement is made that Mr. James Ross has succeeded in his Birmingham Street Railway deal, and that the road will be converted to an electric system immediately.

The Berlin & Waterloo Street Railway Company have placed an order with the Canadian General Electric Company for two G. E. 1,000 railway motors, with controllers.

It is expected that a telephone company will be formed at Gore Bay, Ont., to provide communication between that point and Meldrum Bay, Silver Water and Evansville. The distance is 58 miles.

The Bell Telephone Company are building a line between Carberry and Neepawa, Man. The company have also in contemplation the construction of a loop line between Winnipeg and Brandon.

William Wilds, electrician of the Toronto Suburban Street Railway Company, was standing on a ladder superintending some repairs to the main wire, when the guy wire broke and he was precipitated to the ground. His leg was broken at the ankle.

The tender of the Canadian General Electric Company has been accepted for the supply of electric generators for the new Victoria Hospital at London, now in course of construction. The London Electric Company will supply the switchboard, at \$420.

Messrs. Culverwell and George White Fraser, promoters of the Fenelon Falls power transmission scheme, have notified the town council of Lindsay that they are now prepared to proceed with the work, the necessary capital having been subscribed and the bonds negotiated.

J. Murphy, engineer for the Cornwall Electric Street Railway, has accepted a position in Montreal. Upon severing his connection with the company, he was presented by the employees with a beautiful smoking set as a token of esteem. The presentation was made by Mr. Taylor, superintendent of the railway.

Mr. J. A. Powers has been given, by the Ontario government, a lease of a falls on the Mississauga river, in order to develop a copper mine in the township of Gould. It is said that the falls are capable of developing over 1,000 horse power. Other applications have been received by the government for water powers on the Severn, Wabagoon and Seine rivers.

By the courtesy of the Eugene F. Phillips Electrical Works, Montreal, the ELECTRICAL NEWS has again been honored by an invitation to attend the 20th annual Rhode Island Clam Dinner tendered to the electrical fraternity by Mr. Eugene F. Phillips, general manager of the American Electrical Works, of Providence, R.I. The event takes place on Saturday, September 10th.

On August 15th the ratepayers of Barrie, Ont., by a majority of 170, voted in favor of a by-law to raise \$35,000 for the installation of a municipal electric light plant. Tenders for a municipal plant were taken a short time ago, but contracts have not as yet been awarded. The Barrie Electric Light Company claims that the adoption of the by-law means the confiscation of its property, which has cost \$80,000.

The Shawinigan Water & Power Company, which purposes to develop Shawinigan Falls, on the St. Maurice river, seventeen miles from Three Rivers, Que., is said to have decided to install a plant capable of developing 100,000 horse power. Messrs. T. Pringle & Son, of Montreal, and W. C. Johnson, of Niagara Falls, N.Y., are consulting engineers for the company, which is composed of Messrs. A. F. Gault, Thomas McDougall, Hon. L. F. Forget, of Montreal, and others.

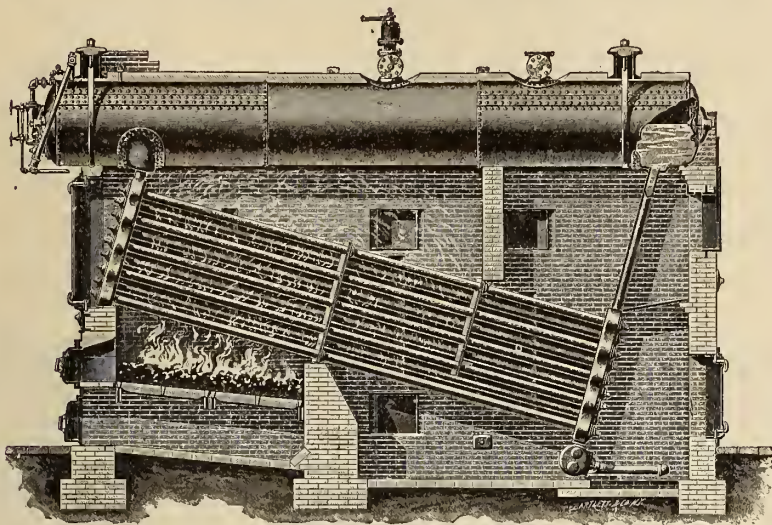
ERRATA.

IN Mr. Wm. Thompson's article on Corrosive and Scale Forming Agents in Boiler Feed Waters, printed in our August number, the position of illustrations marked 1 and 2 was inadvertently transposed.

ELECTRICIAN WANTED

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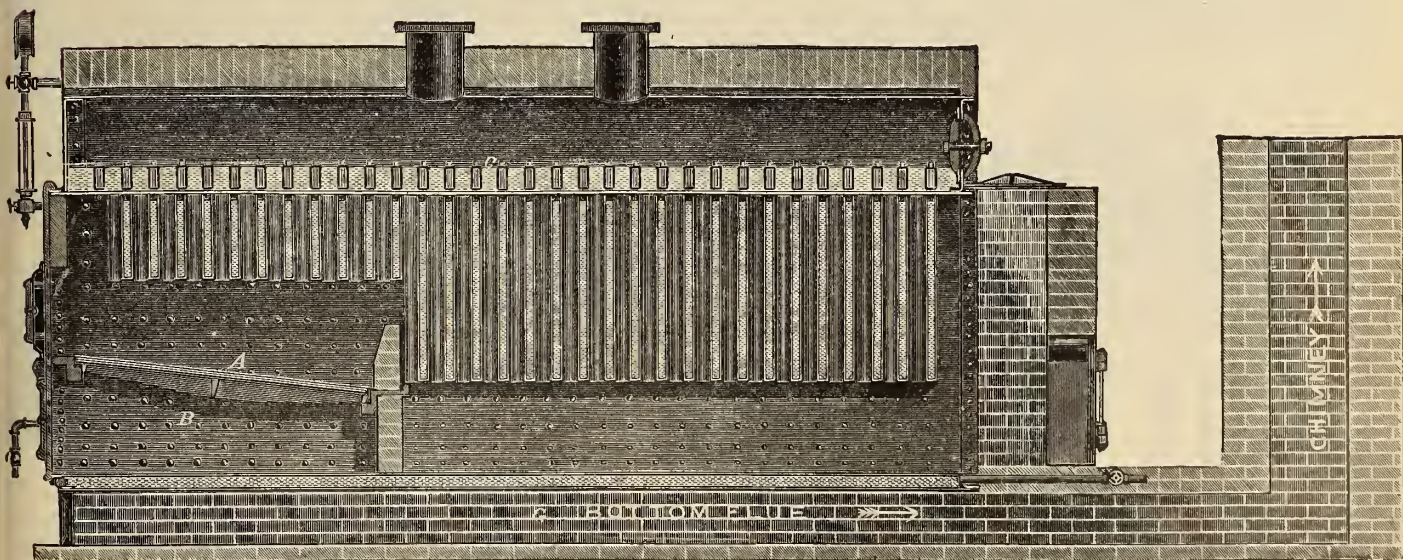
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It is exceedingly gratifying to note the success which has attended the conscientious efforts of The Electrical Engineer Institute of Correspondence Instruction in its attempt to furnish to the profession of electrical engineering absolutely reliable and trustworthy instruction.

Since the organization of this Institute in the early part of the present year, we are advised that every state and territory in the United States, as well as many foreign countries, has furnished its quota of students.

No doubt much of this success must be attributed to the standard set by the Institute, since such eminent authorities as Professor Francis B. Crocker, of Columbia University; Charles F. Scott, the chief electrician of the Westinghouse Electric and Manufacturing Company; Elmer G. Willyoung, the well known electrical instrument expert; William Maver, jr., the celebrated authority on telegraphy; Thorburn Reid, the well known designer of electrical machinery, and many others are included among those who have prepared papers for the courses of the Institute.

Students and others who have investigated the methods of the Institute and examined its series of instruction papers have expressed their complete satisfaction with its methods and its work. The Institute has in this manner gained a large circle of friends almost immediately, and this circle seems to be ever widening. Many manufacturers of electrical apparatus have recognized the value of these courses of instruction to their employees and have consequently afforded the Institute every facility in their power so that its representatives might present to their employees the methods of the Institute. As a consequence students have been enrolled in most of these manufacturing establishments, and the list is growing daily.

We have no hesitation in prophesying for The Electrical Engineer Institute of Correspondence Instruction a continued and growing usefulness.

In connection with the work of the Institute, mention should not be omitted of the beautiful, artistic and interesting book of information, entitled "Can I Become an Electrical Engineer," which is sent free upon request, and which contains one of the

most complete and perfect portrait collections of the prominent scientists and engineers who have succeeded in making the profession of electrical engineering what it is to-day. We strongly urge anyone at all interested in electricity to apply for this book at the home offices of the Institute, 120 Liberty street, New York.

The Roberval Telephone Co., Ltd., of Roberval, Que., is applying for a provincial charter.

Mr. Edward Slade, electrical engineer, Quebec, is at present installing a 40 k. w. plant at the Beauport asylum, to light the several buildings belonging to the institution. It is the intention to utilize the water power which they have for their water service to operate the machinery.

The fourth of the 2,200 S. K. C. generators was set up in the Chambly Electric and Mngf. Co.'s power house at Richelieu, Que., a few days ago, and they have now ready for operation 10,000 h.p. These are the largest electrical units ever built in Canada, and the largest excepting Niagara Falls that have ever been built. Surely electricity is no longer in its infancy, neither is Canada behind in the development of the science.

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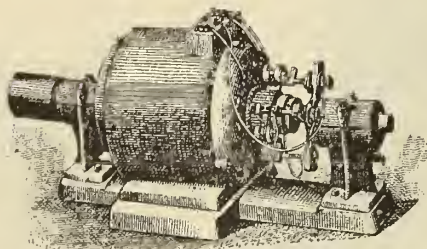
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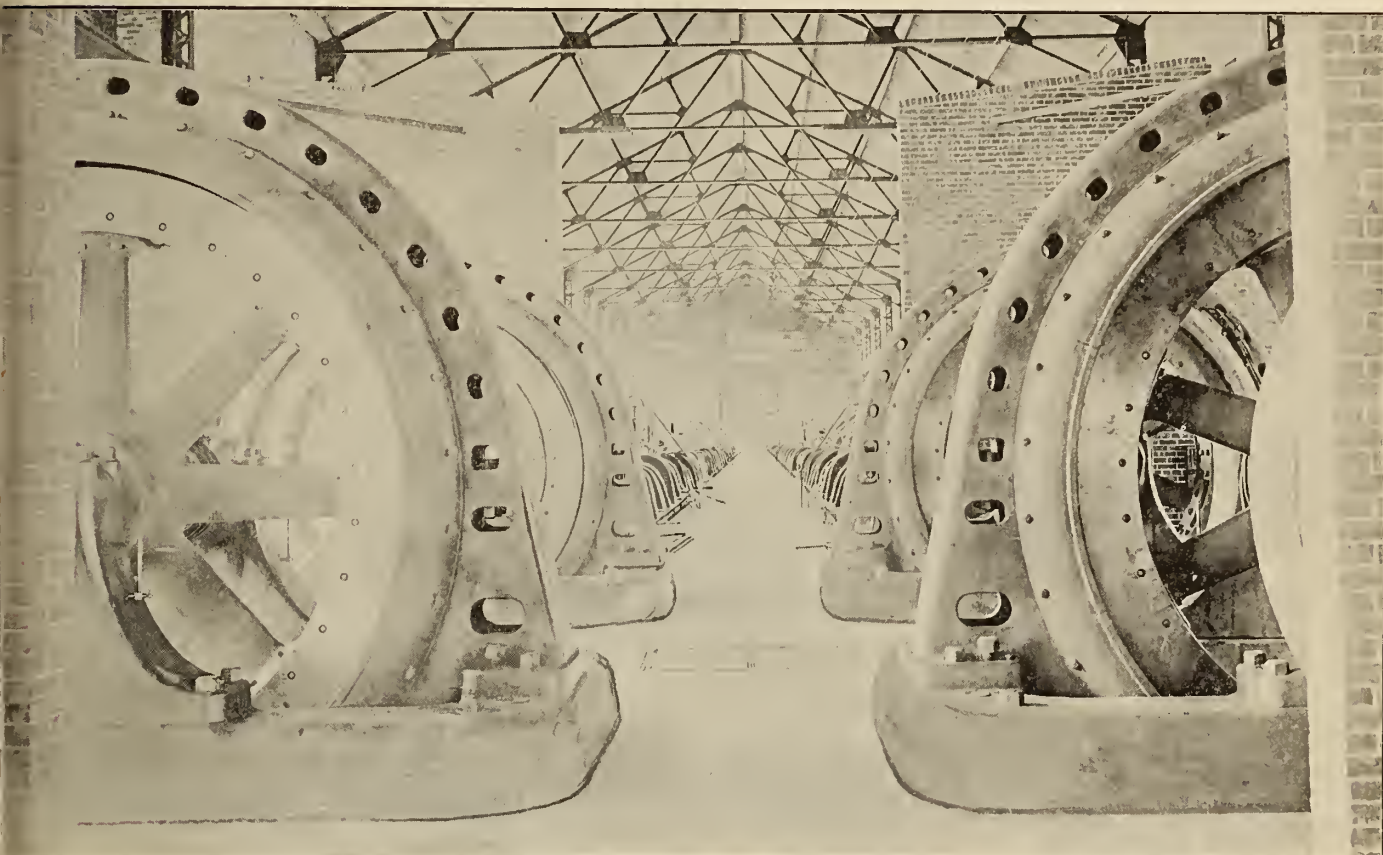
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SPARKS.

Cote & Coursolles, electricians, Ottawa, have lately wired the St. Lawrence Hall on St. Nicholas street for electric lighting.

Commissioner Walsh will recommend the Dominion government to construct a telegraph line from Victoria, B. C., to Dawson.

A syndicate of Montrealers are making arrangements to extend the electric light from Fraserville to Riviere du Loup and Cacouna, Que.

A first-class lineman open for engagement may learn of something to his advantage by corresponding with the editor of THE ELECTRICAL NEWS.

The Electric Reduction Co., of Buckingham, Que., are now installing the large dynamo for their electric plant. The machine weighs nearly 40 tons.

The Benallack Lithographing and Printing Company, Montreal, have ordered from the Canadian General Electric Company one of their latest type motors.

A representative of the Western Electrical Construction Co., of Winnipeg, was recently in Carberry, Man., endeavoring to secure a franchise for electric lighting.

William S. Dockrill, trading in Montreal under the name of W. S. Dockrill & Co., as electrical engineers, has formed a partnership with Ernest W. Sayer, under the former name.

The Deer Park Mining Co., of Rossland, B. C., have arranged with the Kootenay Electric Power Company for the supply of power to operate their mines. The Deer Park Company will shortly let the contract for an air drill plant.

The British Columbia Electric Railway Co., of Vancouver, B.C., have found it necessary to increase their arc lighting plant, and have placed an order with the Canadian General Electric Company for one 125 light multipole Brush arc dynamo.

The Royal Electric Company is installing in the sub-station of the Cataract Power Co., on Victoria street, Hamilton, one of their 30 h. p. S. K. C. induction motors, which is to be used in driving the fans for the air blast transformers.

The Montreal Cotton Co., of Valleyfield, Que., have placed a large increase order with the Canadian General Electric Company for induction motors, consisting of two 50 h.p., one 75 h.p., five 100 h.p. and one 200 h.p. When these are completed the Cotton Company will have one of the largest isolated electric power plants in America, the Canadian General Electric Company having already installed for this company, in generators and motors, a total of between 3000 and 4000 h.p.

The Canadian General Electric Company have just closed a contract with the Lunenburg Gas Company, of Mahone Bay, N.S., for one of their standard 100 kilowatt three phase revolving field type alternating generators. This installation is to be used for the transmission of electric current from a water power, situated about nine miles from the town of Lunenburg, and will be operated without transformers at a potential of 4,000 volts. The company have also received an order for all the wire to be used in the erection of the transmission line.

Following the absorption of the Quebec District Railway Company by the Quebec, Montmorency & Charlebois Railway Company, we learn that the latter company have also acquired the property of the Montmorency Electric Light & Power Company, which furnishes the city of Quebec with electric light and the street railway with motive power. It is understood that the purchase price was about \$1,250,000. As a result of the transaction the three companies above named will be amalgamated into one

concern, and it is probable that the trains of the Quebec, Montmorency and Charlebois railway will shortly be operated by electricity, and that an electric line will be built to Montmorency Falls.

Mr. John Bourke, of North Bay, Ont., has secured a contract for lighting the streets of North Bay by electricity. For this purpose he has placed an order with the Canadian General Electric Company for a 25 light wood arc dynamo, and 15 double carbon Brush arc lamps.

For some time past there has been friction between the Ottawa Electric Railway Company and its employees. The men demanded a wage of \$1.50 for a day of ten hours, and while the company were willing to grant the reduction in the hours of working, they were not disposed to grant the increase in wages. An agreement has now been reached, by which all men who have been in the employ of the company three years and over will receive 15 cents per hour; those under three years and over two will receive 14½ cents per hour; those under two years and over two months, 14 cents per hour. This will apply to all men at present in the employ of the company. Those employed in future will be graded at 13 cents per hour for the first year, 14 cents per hour for the second and third years, and 15 cents thereafter. Ten hours will in future constitute a day's work; over that time will be paid as overtime.

It will be remembered that the city council of Ottawa, Ont., last spring refused permission to the Deschenes Electric Company to supply electric light and power throughout the city. We now observe that a somewhat similar charter has been granted to the Metropolitan Electric Company, represented by a Mr. Lindsay. The Metropolitan Company agree to supply light and power at the following prices: Commercial plan—16 candle power lamps per week, 12c each, no discount. Meter system—1c per ampere hour, 40 per cent. discount and 12 per cent. for cash within 15 days; meters to be charged \$1.50 per year instead of \$3 as at present. Arc light—2,000 nominal candle power, for places using 3 to 9 lights, 20c per light per night; 10 lamps and over, 18c per light. Electric power—1 to 4 h.p., \$50 per annum; 5 to 9 h.p., \$45; 10 to 19 h.p., \$43; 20 to 49 h.p., \$38; 50 to 99 h.p., \$36; 100 h.p. and upwards, \$34. In view of the granting of this charter, it is improbable that the proposed plebiscite on municipal ownership of an electric lighting plant will be taken.

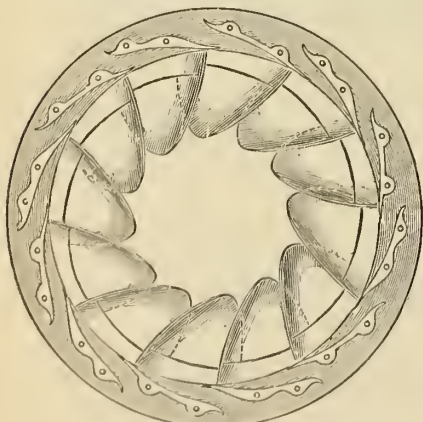
The fourteenth annual meeting of the Royal Electric Co., Montreal, held last month, at which the board of directors was re-elected as follows: Hon. J. R. Thibeaudeau, president; Messrs. D. Morrice, vice-president; H. L. Beique, Allan R. Macdonell, H. S. Holt, J. A. L. Strathy, A. Brunet, Edwin Hanson, Robert Cowans and Wm. H. Browne, general manager. The annual report stated that the gross amount for the year to credit of revenue accounts for the business transactions of the company aggregated \$955,826. The expenditure for labor, materials, operation, maintenance and general expenses amounted to \$636,057, leaving a gross profit of \$319,769. From this is to be deducted interest and fixed charges amounting to \$42,609, making an aggregate net profit to the company for the year of \$277,160. The lights in operation are direct current arc system, 1842; alternating current, incandescent and arc, 70,089. In motors there are 1041 horse power. In additional equipment last year there was expended \$101,707. This includes \$58,000 for lighting stations and general construction. The increase in incandescent lights connected during the year was 7,736, or nearly as many as during the two years ending May 31st, 1897. Altogether the report was considered most satisfactory, and augurs well for the future of the company.

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Working Superintendent of Electric Light and Waterworks Plant. Applicants to address T. Ed. Oakley, Secretary-Treasurer, Fort William, Ont., and to state age, qualification and salary expected, together with recent testimonials and reference.

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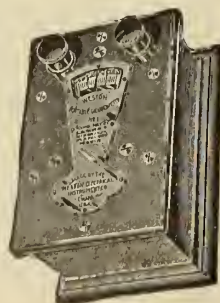
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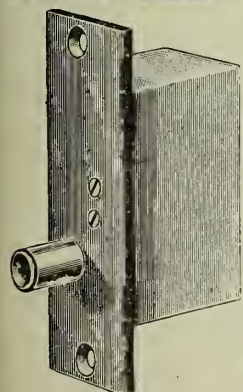


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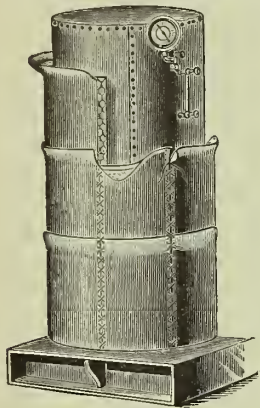
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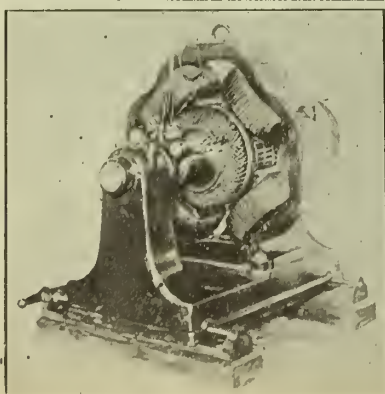
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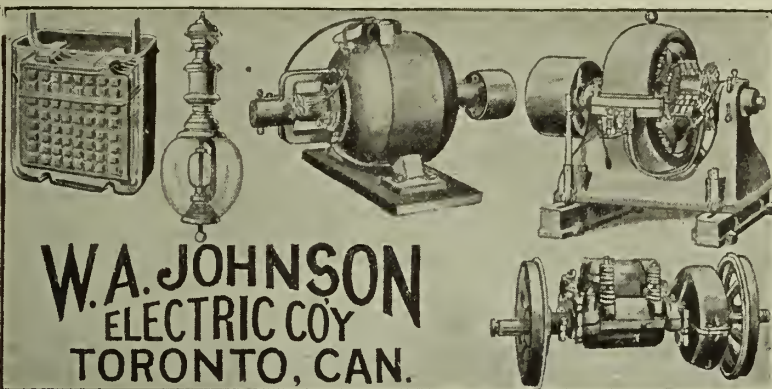
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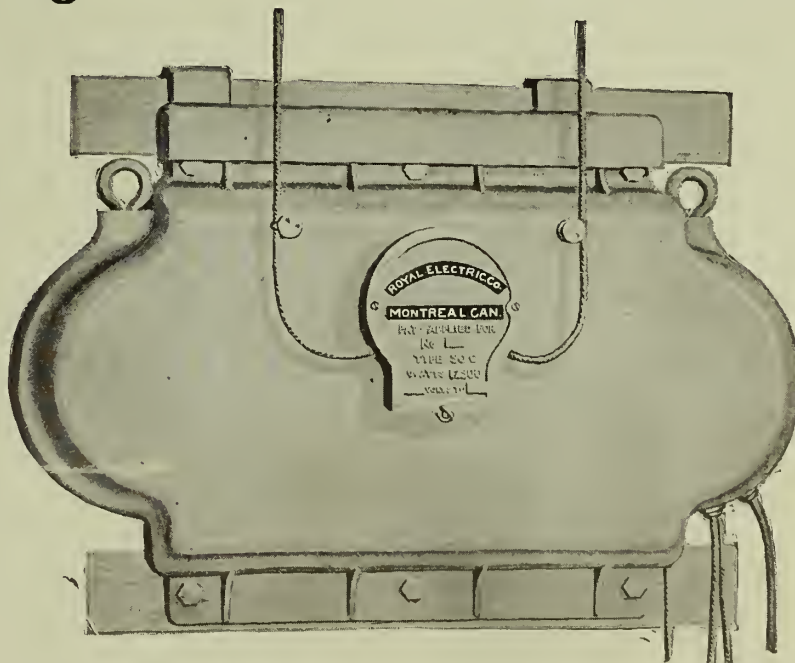
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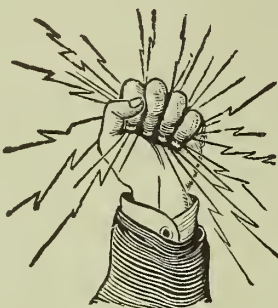
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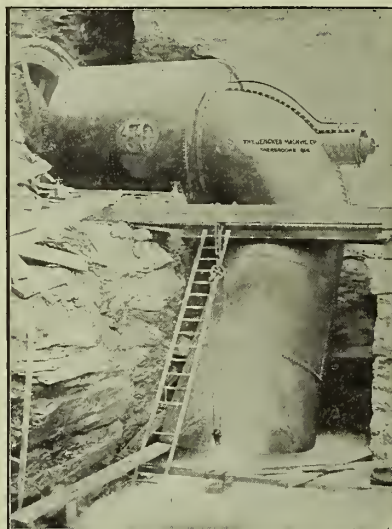
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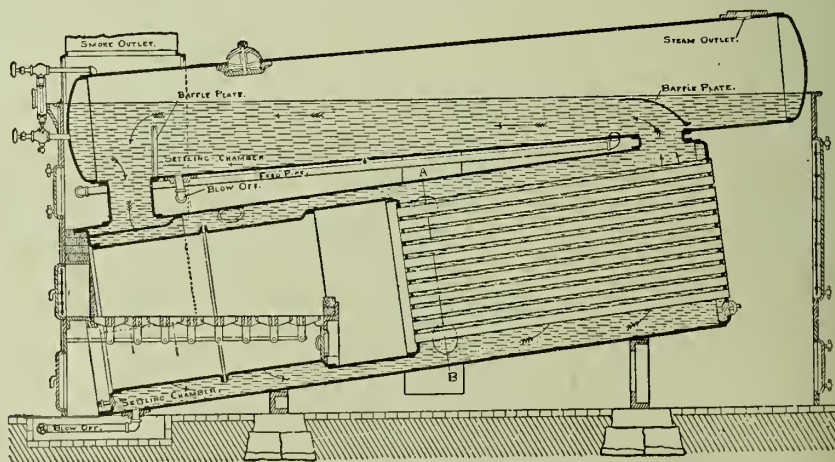
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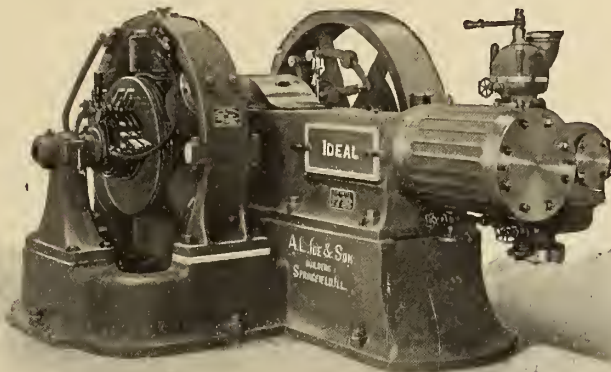
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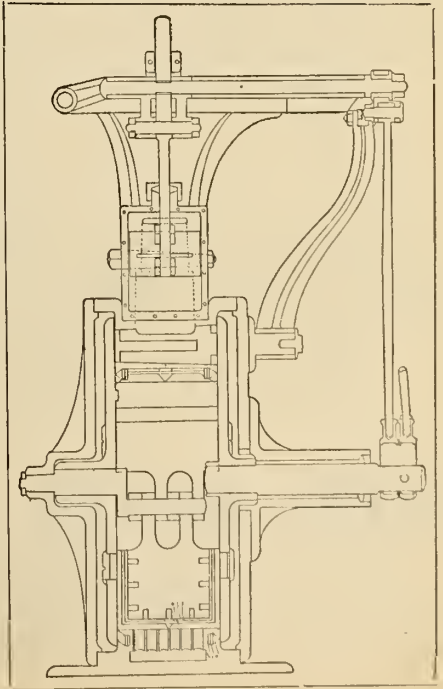
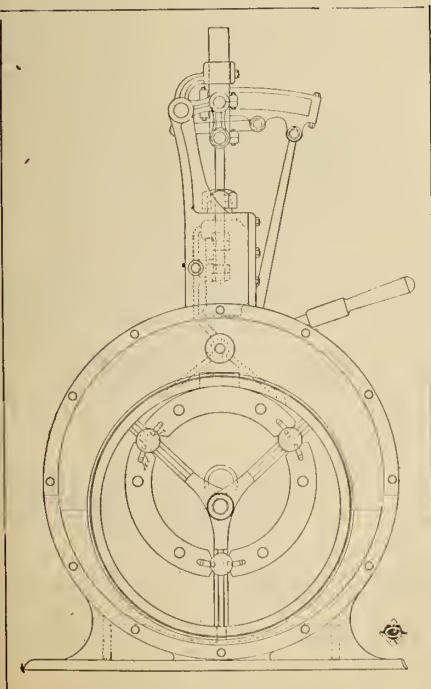
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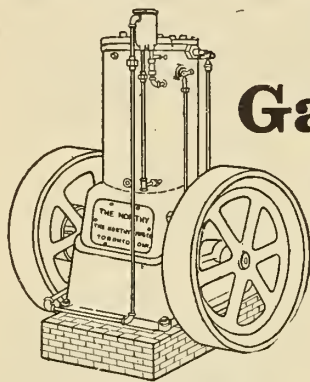
THE JUBILEE GRATE BAR CO. of Toronto, Limited,

Office and Factory: Esplanade, Foot of West Market St., TORONTO, ONTARIO
and THE GOLDIE & McCULLOCH CO., Limited, Galt, Ontario

[COPY.]
THE JUBILEE GRATE BAR CO., Toronto.

TORONTO, Jan'y 8th, 1898.
DEAR SIRS,— Answering your enquiry as to our opinion of the Jubilee Grates, would say that we have had them in use for over a month, and have found them very satisfactory. We are saving over \$2.00 in our coal bill per day for 10 hours' work. With the old grates we could not get steam without using Screened Lump Soft Coal; now we use Soft Coal Screenings, and we are developing about 24 h.p. more than we could with the old grates. You have already taken a memorandum of the tests that were made of the old and the new grates; we have checked over the figures to-day and find them quite correct.

Yours truly,
(Sgd.) THE TORONTO RADIATOR MFG. CO., Limited.
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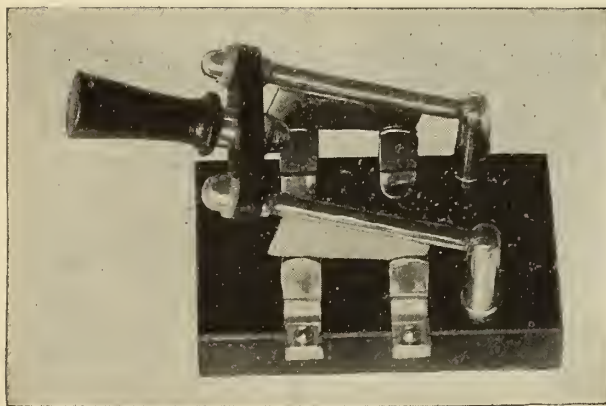
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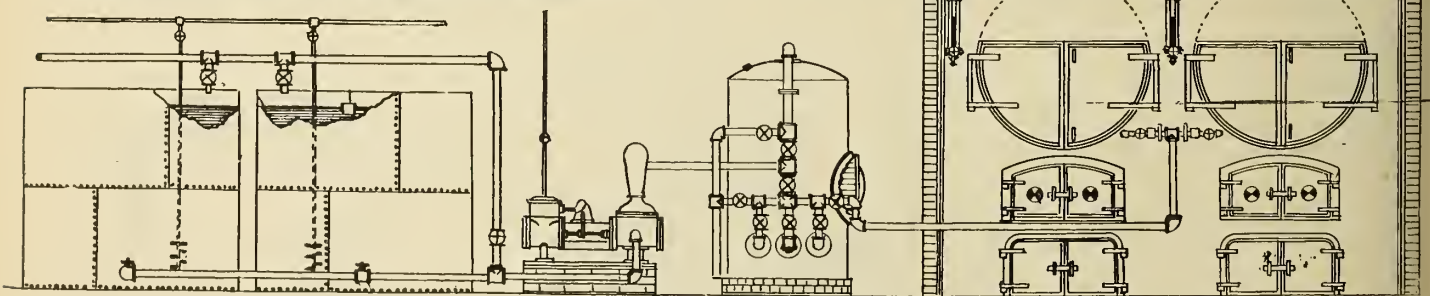
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CANADIAN
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AND
STEAM ENGINEERING JOURNAL.

VOL. VIII.

OCTOBER, 1898

No. 10.

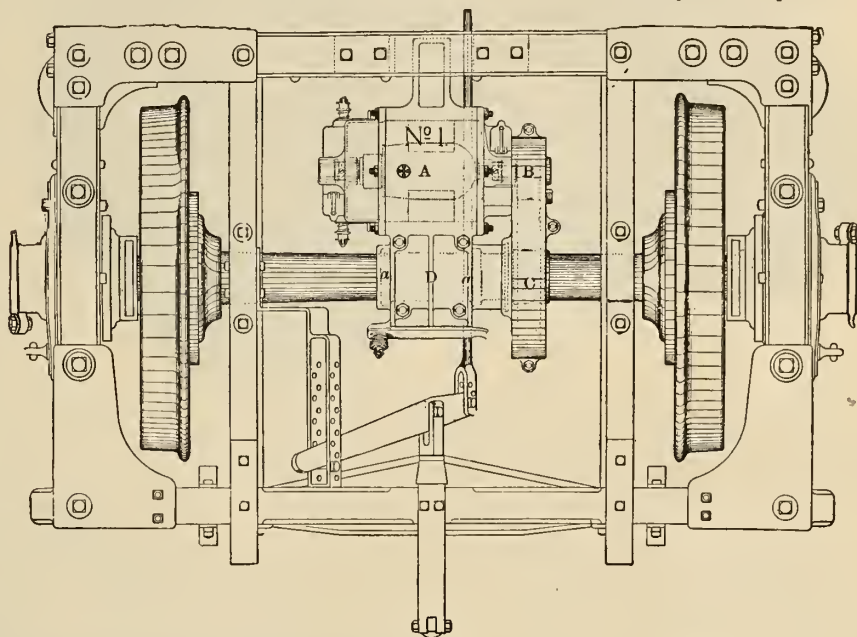
ELECTRIC LIGHTING OF RAILWAY CARS.

IN European countries the electric system of car lighting has been adopted very largely. Almost all the private railroads of Sweden and Norway have electric light, also many German and Austrian private railroads, as, for instance, the Dortmund Gronau-Enscheder, the provincial railroad of Westphalia, the Altdamm-Colberg, the Marienburg-Mlawka, the Prignitzthal, the Mecklenburg-Frederic-William, the Wittenberg-Perleberg, the Arad-Czanad, etc. Many of these have adopted this method of lighting within the past three years. In the United States we also find the system in use to some extent.

Not to be outdone by other railroads, the directors of the Canadian Pacific Railway have for some time been investigating the various methods of lighting, as a result of which they are now equipping ten sleeping cars with the American Railway Electric Light Company's system, of which illustrations are given herewith.

This system of car lighting consists of a dynamo mounted upon the truck of the car, one end of which is supported by a stirrup from the truck, and the other by the axle. It is driven by a direct gear, which revolves two and one-half times to every revolution of the car wheel. The part resting on the axle rests on a split sleeve. This split sleeve finds its bearings by means of adjustable jaws, so arranged as to take up any irregularity of

the train may reach great extremes of variations, and the dynamo, being directly geared, would normally reach great extremes of current, the current generated by the dynamo is kept substantially uniform during all the variations of speed between twenty miles per hour



SYSTEM OF ELECTRIC LIGHTING FOR RAILWAY CARS.

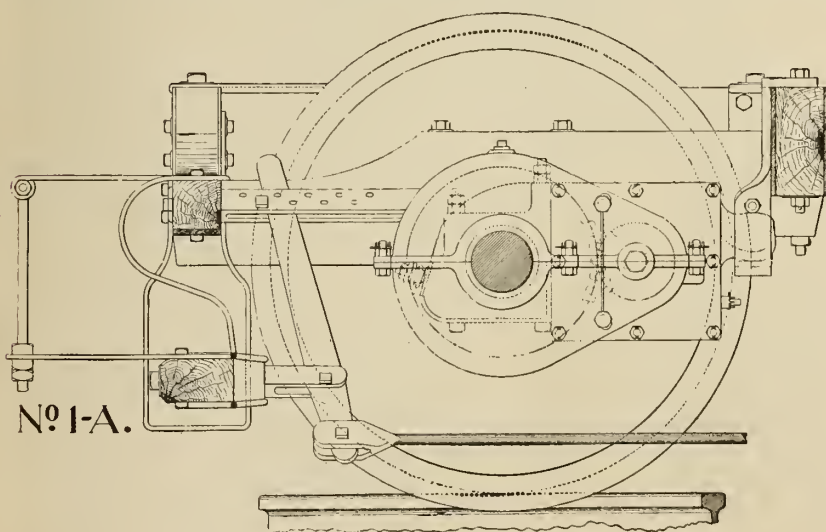
and the maximum ability of the locomotive. In other words, although the dynamo at a speed of sixty miles per hour is revolving three times as fast as it is at a speed of twenty miles per hour, the amount of current generated is the same.

In connection with this there is an automatic cut-out, so adjusted as to throw the dynamo into circuit with the lamps upon its reaching a potential equal to that of a small storage battery supply, and throwing it out of circuit upon its dropping below. The effect of this is that when the lamps are burning, and the train running at twenty miles per hour, the lamps are fed directly from the dynamo, and the small surplus of current goes through the batteries. When the speed falls below twenty miles per hour the cut-out works automatically, and as long as it continues at its low rate of speed the lights are drawn direct from the storage batteries, which are capable of supplying the lights independent of the dynamo for from six to twelve hours.

The porter is given no instructions beyond being told to turn the lights on when he wants them, and turn them off when they are no longer required.

The system is being installed on the C.P.R. cars by the American Railway Electric Light Co., of New York.

Another feature of this system is, that in running during the daytime, when the batteries are full, the very act of turning off the lights cuts down the efficiency of the dynamo to a point where it generates only the



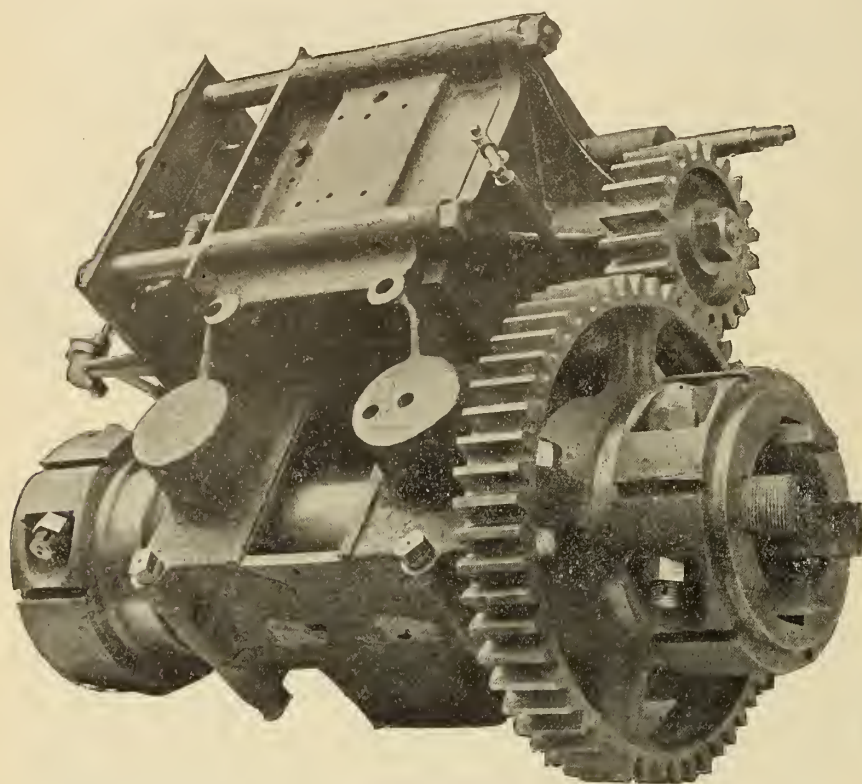
SYSTEM OF ELECTRIC LIGHTING FOR RAILWAY CARS.

the axle, and they engage close to the wheels, leaving the central part of the axle free to spring in rounding curves and going over irregularities in the road, and concentrating the weight where it is least felt.

A peculiar feature of this system is the regulating device. This is so arranged that although the speed of

normal current necessary to pass through the batteries in order to keep them in the best of condition.

Should it be desirable, as it very frequently is, to introduce electric fans into the sleeper during the heated months, the current generated by the dynamo would be



VIEW OF AXLE DEVICE—SYSTEM OF ELECTRIC LIGHTING FOR RAILWAY CARS.

amply sufficient to keep a large number of them, if required, in operation, while yet serving the batteries with all that they required.

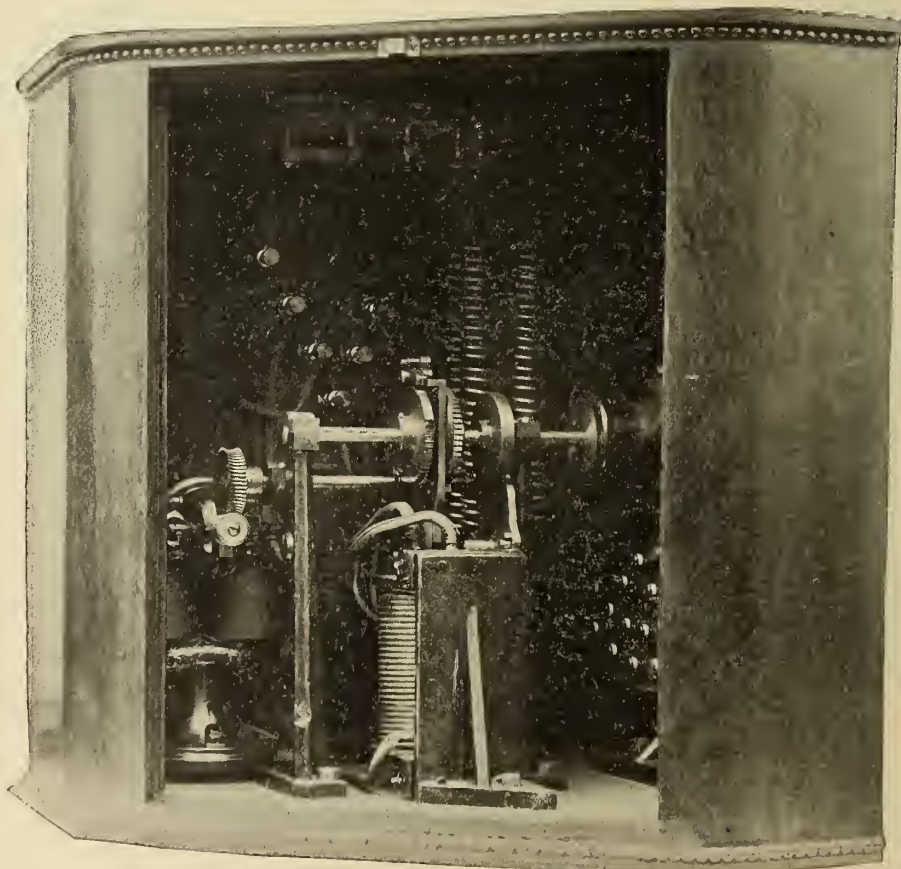
An evidence of the improvement in business conditions attending the manufacturing and other interests throughout Canada is markedly indicated by the large number of isolated electric lighting plants being installed this season, and the many increases in the generating capacity for both lighting and power work which are being made in central station plants.

Mr. D. A. Gordon, of Wallaceburg, Ont., who has secured a franchise for the installation of an incandescent electric lighting plant in the town of Tweed, has recently given an order to the Canadian General Electric Company for one of their 500 light single phase alternators. The order also includes the necessary material for the erection of a complete lighting plant.

Mr. T. Ahearn, president, and Mr. J. D. Fraser, secretary-treasurer of the Ottawa Street Railway Company, were in attendance at the annual convention of the American Street Railway Association held in Boston last month. As a result of their observation, the company will adopt a system of book-keeping recommended by a special committee of the association. This system will, it is claimed, secure uniformity in the accounts of all the street railways throughout Canada and the United States, and enable comparisons to be made of expenses in all departments.

AN ELECTRIC DELIVERY WAGON.

THE first electric motor wagon to be used in Canada solely for a commercial purpose was recently added to the delivery equipment of the Robert Simpson Company, Limited, of Toronto, and has been in service for the past six weeks. The vehicle, of which a view is shown on opposite page, was manufactured by the Fischer Equipment Company, of Chicago, and is known as their No. 2 coach delivery wagon, the equipment consisting of forty 120 ampere hour cells of batteries, which operate two $2\frac{1}{2}$ h. p. motors. The motors as applied to the propulsion of this vehicle are independent in their action one from the other, inasmuch as one motor is attached independently to either rear wheel of the vehicle. These motors are four pole machines, with series wound fields and also series wound armatures; on which but two brushes, ninety degrees apart, are used. The windings of the armature itself are what is known as coil wound, that is, coils are wound up on formers and subsequently placed in slots in the armature, the construction of the latter being what is known as the iron wound form, with but one-sixteenth inch clearance between the armature core and the field magnet, the object being to give the greatest torque with the smallest amount possible of field energy. In other words, the air gap being reduced to the smallest possible space, and the magnetic circuit, consisting of cast steel in the pole pieces and sheet steel laminated discs in the armature, reduce the amount of field winding to a minimum, and hence its resistance is very low. The commutators are made very large, and current is delivered to them through carbon brushes, which have an area of contact with under one hundred per



REGULATING DEVICE—SYSTEM OF ELECTRIC LIGHTING FOR RAILWAY CARS.

cent. over load equal to 40 amperes per square inch of contact surface. The speed of the motor is 1,000 revolutions at $2\frac{1}{2}$ h. p., and is directly geared with a $2\frac{1}{2}$ " pinion to a 26" driving wheel fastened to the wheel of

the wagon, which wheel is 46 inches in diameter, and at a thousand revolutions of the motor gives a speed to the vehicle of a trifle over fourteen miles per hour.

The batteries of the vehicles are arranged in four trays, and the control of the various speeds of the wagon are divided into three; one in which the four trays are in parallel to the motors, giving twenty volts; one in which two each of the four trays are in series and the two series in parallel, giving forty volts; and one, the maximum speed, in which all four of the trays are in series, giving eighty volts. The output of the batteries at the three hour discharge is $27\frac{1}{2}$ amperes for three consecutive hours, and the amperage required of the two motors to operate the vehicles at fourteen miles per hour on a hard level road is 26, that is, thirteen amperes per motor, which gives a three-hour continuous run on a level roadway at fourteen miles per hour—an actual mileage capacity of forty-two miles on one charge of the batteries. The wagon is only rated, however, at twenty-five miles on one charge of the batteries, as high winds, muddy roads, grades, etc., create an extra demand for power which must be provided for; also, the fact must be considered that oftentimes batteries will not be fully charged.

One of the strongest features of the construction of the wagon is claimed to be the brake application, the controller handle and the brake handle being identical and arranged in such a way that the brake cannot be applied without first cutting off the current from the motors, and the current cannot be

running gear of the wagon is such that no matter how uneven the road is, no strain is brought to bear upon the gears as between the motor and driving wheels, as the front axle is independent in its adjustment to unevenness of the road. The accompanying illustrations were

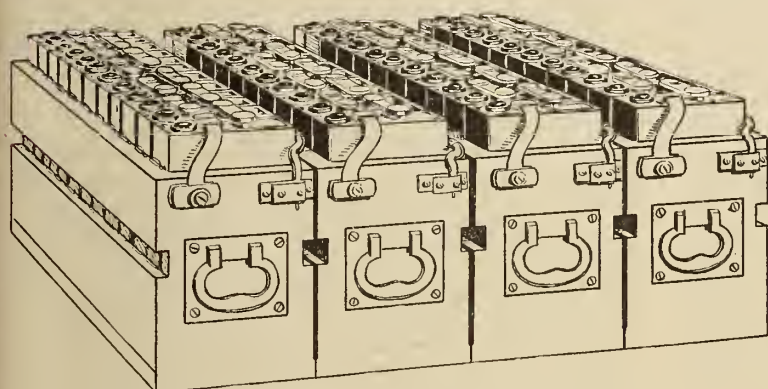


ELECTRIC DELIVERY WAGON OF THE ROBERT SIMPSON COMPANY, TORONTO.

kindly loaned by the owners of the carriage, the Robert Simpson Company.

Mr. Jay P. Graves, manager of the Big Three Gold Mining Company, at Rossland, B. C., has just placed an order with the Canadian General Electric Company for a 75 kilowatt synchronous motor. This motor is to be used in the development of their mine at Rossland, and the current for its operation will be derived from the power circuits of the West Kootenay Power and Light Company.

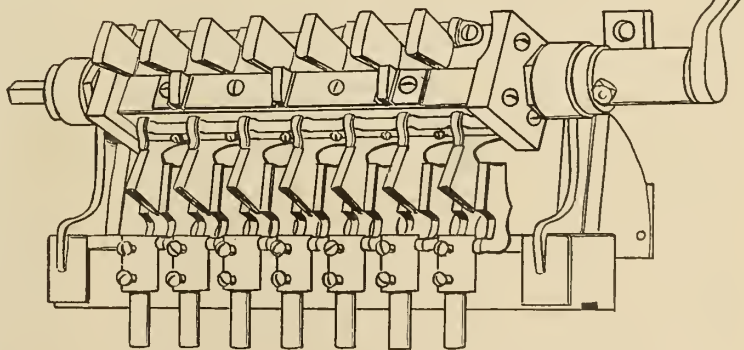
The town of Renfrew, Ont., is now receiving cheap light as the result of competition. Early in the eighties, Mr. A. A. Wright installed an arc plant, and later put in an incandescent system, operated by steam. Shortly after he had put in the latter plant, Messrs. Mackey & Guest, who owned and operated a grist mill on the Bonnechere river, were prevailed upon to establish an incandescent plant, and operated it in connection with their grist mill, using water power. As a consequence the price dropped from one cent per lamp per



STORAGE BATTERIES USED IN ELECTRIC DELIVERY WAGON.

turned on to the motors without first liberating the brake. This makes it impossible for an inexperienced man to make any mistakes in handling the wagon. The batteries are arranged in trays, as before said, so that they can be divided for control at different speeds, also so that they may be removed from the vehicle for the insertion of duplicate sets, but means are also provided whereby the batteries can be charged in the vehicle, and this is the common way of operating, the current first being cut off from the motors, which is made absolute by the removal of the key after the switch is set in position, and the controller being set upon third speed, which connects all the batteries in series. In this way they are charged directly for 110 volt circuit. The time required for charging under these conditions, when the batteries are fully discharged, is about three hours.

From the foregoing it will be seen that by charging the batteries at noon, it is possible to operate the vehicle sixty or seventy miles per day. The motors are mounted on ball bearings, as are also the wheels of the vehicle, and unless specially ordered, the wheels are of regular carriage type set in hard rubber tires. The motor suspension and arrangement of



REVERSIBLE SWITCH USED IN ELECTRIC DELIVERY WAGON.

hour to three-fifths of a cent, at which it still remains. Some time ago an attempt was made by the companies to amalgamate, but the negotiations fell through.

A new electric light plant will be added to the Frontenac Hotel, Round Island Park, near Kingston.

FIRST CONVENTION OF THE MARITIME ELECTRICAL ASSOCIATION.

THE first regular convention of the Maritime Electrical Association was held in the assembly room of the Church of England Institute, Halifax, N.S., on Tuesday, Sept. 27th, 1898, at 10:30 a.m. The following persons were present:

E. L. Nash, Lunenburg; J. Daley, Digby; Fred. A. Bowman, J. H. Winfield, New Glasgow; J. A. Anderson, J. Graham, W. Pickles, F. A. Hamilton, P. R. Colpitt, E. T. Freeman, C. E. Harris, L. H. Smith, J. C. Siebert, J. Christie, Halifax; S. G. Chambers, J. L. McDonald, Truro; J. A. Young, Sydney; W. A. Winfield, Windsor; L. C. Gilling, Bridgewater; J. B. Mortimer, Toronto.

The President, Mr. F. A. Bowman, of New Glasgow, occupied the chair. The minutes of the organization meeting held last April were read and approved, after which the president made a few opening remarks, stating that it had been thought advisable to make the first convention largely of a social nature, as that was the first step towards harmony and strength. The committee of the Halifax members, he stated, had gone to a great deal of trouble in order to provide for the entertainment of the association, but unfortunately the weather had marred the arrangements. It had been arranged to have an excursion by steamer on the harbour, with lunch at Bedford, but this would have to be abandoned owing to the rain.

The secretary-treasurer then read his report, as follows:

At our first meeting held on April 12th, 1898, fifty-six gentlemen handed in their names either personally or by proxy, signifying their intention of becoming members of the association. Since then there have been three members elected, making a total of fifty-nine. The receipts have been: 45 membership fees, \$90.00, and the expenditure, for various items, \$57.55, leaving a cash balance of \$32.45. There are fourteen fees still unpaid. I may be permitted to call attention to the fact that the membership fees already paid in are intended to cover the present association year, which ends 31st March, 1899. We must therefore depend, for the financial requirements of the present year, solely upon the balance in hand, the unpaid fees and the fees of new members who may come in during the year. Thus you will see that there is need for personal effort to extend the membership, and for careful husbanding of resources, in order to finish the year with a balance on the right side.

J. H. WINFIELD, Secretary.

The president then called the attention of the members to the necessity for an increase in membership, and requested them to use their best endeavors to get others in their respective districts to become members of the association. The majority of the managers of the different companies had already joined, and if they would induce their directors and larger shareholders to take an interest in the work he thought much good might be accomplished.

The president then read his address, as follows:

PRESIDENT'S ADDRESS.

In greeting you at this the first regular convention of the Maritime Electrical Association, it gives me great pleasure to feel that, in meeting here to-day, we have made a great step in advance. We have the honor of being the first section of the Dominion to establish a local organization to work in unison with the central one, the Canadian Electrical Association. As was pointed out in the circular letter issued previous to our organization meeting last April, it was felt that owing to the magnificent distances with which we have to deal in this, our great Dominion of Canada, it was impossible to arouse a very deep interest in the Canadian Electrical Association among the electrical men in these provinces, because it would be impossible for many of them to attend the conventions. It is difficult to get up a warm enthusiasm in an institution the leading men of which you have never met, and may never meet, and the meetings of which you do not hope to be able to attend. Although the benefits to every one belonging to that association would be undoubtedly great, it is hard under these circumstances to get men to see it. They feel as if they were paying their annual fees without receiving an equivalent. It was therefore thought that if an association of a more local character were formed, that would draw together those who are able to go only a comparatively short distance, and if its conventions were held at points accessible to them, they would get to know each other, and also to realize the benefits of such an association, and would then be more ready and willing to give their support to the larger central institution, either by individually becoming members of it, or as a body lending their weight to assist it in any work affecting the industry generally, or in both ways.

When our movement towards organization was announced to the Canadian Electrical Association, we received some very kind

words from them. The executive council expressed the hope that means would be found to have the two associations work in unison.

At this our first convention we have not been able to get a very extended list of papers to lay before you, and there is not a very large amount of business to be transacted. The spring and summer is recognized by all workers in technical associations as being the most difficult in which to get papers written. This is naturally so, not only on account of the weather, which is much more conducive to outdoor recreation than to indoor writing, but also because in our business most of us are busy working at extensions and improvements in our outside plant at this time of year, and in preparing for the rush of the fall and early winter's work. On the other hand, the season is well adapted to what must be a very large and important part of the work of our first convention, that is to say, the getting to know each other. Dotted down as we are all over the Maritime provinces, considerable distances apart, comparatively few of us know many of those engaged in the same business, except in the nearest towns. If this first meeting accomplishes no more than to do away with some of this state of affairs, and to send the members home feeling that they know more about their co-workers in these provinces, and that they have picked up some knowledge of other plants, a great and good work will have been done, and a solid foundation laid for future use. The local Halifax members have grasped this idea most strongly, and have gone about its accomplishment in an energetic fashion that will appeal very strongly to our sociability. Being myself from an outside town, I feel at liberty to thank them for their hospitality to us, and, as President, I thank them for their efforts to make our first convention a success. The present time was selected because cheap railway fares are available, and because it was thought that many who would be coming to the exhibition could not make a second trip a month or so one way or the other from it. This renders the efforts of our Halifax members the more laudable, as the present time is distinctly inconvenient to them, owing to the crowds that are in the city. We are gathered here as members of a business which is eminently a creation of and typical of the age, and in this gathering together we are also following the trend of the times.

Centralization and organization are the ruling ideas in every department of work to-day, and in fact almost equally so in our amusements. There is no question that the marvellous progress of the latter part of this century is due almost entirely to this movement. Individual workers could never have accomplished the results that have been attained within the life time of the youngest of us, if they had worked each on his own line without knowledge of what others had done or were doing. The capabilities of the greatest are limited, and each one, if he is to advance himself and his work, must begin where the man before him left off; there must be no time wasted in travelling over the same ground. Experience shows also that to really get the fullest benefit from another man's work, you must not only study him in print, in the abstract as it were, but also in the concrete, in the flesh and blood. Year by year we find the number of conventions and annual meetings steadily increasing in numbers, size and importance. This in itself is a proof that they meet a need, and accomplish good results. It is very easy for those who stay at home and never join in any of these gatherings to say that they are just a fad and a fashion and will die out shortly; that people feel very big to go to a convention and perhaps read a paper, and get their names in print. But hard-headed business men would long ago have ceased to patronize them if they had not seen the practical good that comes from them. Conventions are human institutions, and therefore are a mixture of good and evil, and often do not reach the ideal of the leaders and more earnest minds in them, but nevertheless, I do not believe that there is any person who has ever attended one, unless he is given over to a spirit of absolute cynicism or pessimism, but will admit that he has derived great benefit from it. Each one of us is struggling along in our larger or smaller sphere, meeting our special difficulties as best we can, conquering them after a long struggle, or sometimes being conquered by them, doing what we think is right and best, and always wishing that we knew more or could learn more. We always have a floating wish, more or less strong, according to the amount of self-conceit and self-assertion that we possess, to know how someone else would get out of the difficulty we are in. There is also an idea that possibly the other man may have a better method or a better system than we have. It is this feeling that is at the root of the convention idea. The strong movement of the last few years towards standard methods, not only of manufactures, but also of keeping accounts and making up reports, is the result of the feeling that more good benefit is derived from exchanging figures with your neighbors than by keeping yourself and your affairs secret. From this idea grows a convention, and at it are gathered together a number of men who are all struggling with the same business and therefore often with exactly the same difficulties. Papers are read and discussed, and we get a number of good ideas. The papers are generally on broad, fundamental principles, and were it not for the discussion and the personal opinions and experiences brought out in it, we would not derive as much benefit as if we sat down at home and carefully perused them in our technical journals.

But outside of the convention hall, between the sessions, at the hotel table, on the little excursions that generally take place, in quiet corners of the hotel office, you see little groups of two or three in earnest conversation. It is in those groups that much of the best work of the meeting is done. It is remarkable how even in an assembly of several hundreds, where the majority are necessarily unknown to one another, those whose experiences are somewhat familiar are drawn together. You meet those whom you already know, and are introduced to others, and the conversation of course gravitates towards the lines of work in which

you are all interested, and it will not confine itself, as the formal paper is apt to do, to general principles, but goes right down to actual details of work and methods. Presently you find that the other fellow is asking you if you ever had such and such a difficulty, and how you managed it, or how you did a certain piece of work and what it cost you. You lay your heads together and compare notes and exchange figures, and as a result you both find out just where you are making a mistake, or what would have been a better method of going to work. All this, perhaps, sounds very true and trite to you, and you all feel that you knew it before.

What I want to impress upon you as to the great value of conventions may be divided under two heads. Firstly, if you have been working comparatively alone, without anyone near you in the same line of business, there is a great deal of encouragement just to get into such a gathering and have it brought home to you that you are one member of so large and important a business. You see the style of the majority of the men about you, and feel that they are after all not all of so much greater ability than you are yourself, and if they are succeeding there is no reason why you should not; you hear those few who really do stand head and shoulders above the crowd speaking of the difficulties and problems they have to meet, and you feel that if they have so much trouble with all their foresight, experience and ability to help them, it is not to be wondered at if you get into a hole sometimes. Secondly, you make acquaintances which later ripen into close business and personal friendships, and when the time comes for united action on some point affecting the industry, you know just who is the one to lead and who is to be depended upon.

The feeling about the interchange of information has been steadily gaining ground for many years. In former times the great strength of each man's business was the trade secrets he had that no one else had, and the fact that if he built a machine you had to go to him for every bolt to repair it, because no one else's bolt would fit. To-day it is all different; everything must be made to a standard, and all parts must be interchangeable. With this progress the trade secret has largely vanished, and information as to processes and method of manufacture is gathered and spread broadcast by technical societies and trade journals.

The vital question back of all this, namely, the cost of production and the methods of keeping accounts, has been the longest to yield to this movement for the dissemination of knowledge. Men seemed to think that while they could afford to tell their neighbor a good deal or all about how they did their work, in order that they might get ideas in return, that they must keep their methods of keeping costs and the costs themselves closely secret; that if they let their competitors and the public know just what it cost them to do work and what profit they were making, that the knowledge would be used against them. This feeling is now disappearing to a certain extent, and during the last two or three years information has been made public that would hardly have been entrusted personal friends previous to that. Signs of this are all around us. One of the leading engineering periodicals has been publishing series after series of articles on shop cost, and methods of keeping them. In these the methods of accounting the actual costs are given from many of the largest and most successful works in the United States. The fact that so much space in this journal has been given to this subject shows not only that the articles are highly appreciated, but that the heads of these establishments find it to their advantage to give out this information. Another sign is the formation of a committee of the National Electric Light Association to take up the question of a standard system of keeping accounts. And a still stronger move is the formation among the street railway men of a Street Railway Accountants Association, which held its second convention two weeks ago in Boston, simultaneously with the street railway convention. Similar work is being done in the steam railway world. Probably the keen competition and the reduction of prices, and with them of profits, has largely forced on this movement, it being in many cases a matter of good policy if not of actual self-defence to show the public that prices are being forced down to or below the living point, and to break up the idea that nearly everyone has, consciously or unconsciously, that enormous profits are made in every other business except his own.

I would like to say a few words on the matter of the preparation of papers. Every association, except those with the largest and most learned membership, experience considerable difficulty in getting papers for the meetings. Much of this is due to a misunderstanding on the part of the members. They have an idea that a paper must be a learned discourse of considerable length, composed on a subject that no one else has touched upon, or else bringing out some strikingly new or original ideas on some older subject. They think that it must have an oratorical prologue to properly introduce the subject, a lot of mathematical formulae strewn through it like the currants in a cake, and some illustrations with letters of reference all over them to represent the raisins, and then the whole thing closed up by an eminently logical peroration; that they must accompany the reading of it by elaborate verbal explanations, and have a blackboard at hand that they must cover with xs, ys and zs, until the audience has been worked up into such a state of bewilderment that it is ready to accept any statement the author likes to make. Now, this is an entirely mistaken notion. The theoretical and mathematical papers have their value, and a very high value it is, and we could not do without them. But we have room and a very large demand for shorter and more practical papers. The large societies and institutes can be depended upon to give us an unlimited supply of the former class, but it is from just such men as we have among our own members that the latter class must come. What we want is short practical papers touching on the difficulties and experiences that we all have in our daily work. The English Institution of Civil Engineers, the leading engineering society in the world, with a membership of over 6000, publishes many very short papers each year, as well as the longer ones, which it, of course, has comparatively little difficulty in obtaining. The short ones, as a

rule, come from practical engineers all over the world. One man has had some trouble with a bridge pier and he sends in his experience, and a couple of pages of print holds it all. Others have met other small problems and attacked them successfully, and they give their fellow members the benefit of their work. Several of the large societies on this side of the Atlantic are doing the same thing and sending to their members each month a number of small papers, many of which cover only one page. A member of one of these societies assured me that he got many very valuable suggestions from them. Some, of course, were not directly in the line of work which he was following, and others contained points that he particularly wanted to know.

I want, therefore, to impress on you all that if asked to present a paper you do not begin to say that you have neither time nor ability, because you have both if you look at the matter in the light in which I have been trying to put it to you. Every one of us has had some experience that it would be useful to others to know of, and every one of us is capable of writing it down in a few plain words so that it can be understood. Do not think that a matter is too small to be worth talking about. If an experience has been of value to you it will be of value to someone else, and that someone else will be glad to get it, and your telling it to him will save him having to work it all out for himself. Even if he has had the same experience he has dealt with it in a different way perhaps, and will say so in the discussion, then each learns from the other and the rest of the association has the experience of you both to draw from. Again, a paper that does not amount to a great deal in itself may start a discussion that will draw out much valuable information. This is a very common experience in technical societies. The discussion often does not follow the lines of the paper at all, but the paper suggests some idea to a listener and he brings it forward and it is taken up by others and the ball set rolling.

So I repeat, if you are asked for a paper do not blush modestly and disclaim the requisite time, knowledge and ability, but stop and think over your work and see if there is not something that will be of value to others to know. Perhaps you spiked and painted a lot of poles and kept account of the material and labor on them. Now, this is a very simple every-day operation in the business, but I will venture to say that a great many of your fellow members would be very glad of some information as to probable cost and quantities. I know I had a good deal of difficulty in procuring it the first time I needed it, and am open to receive much more than I now possess. Again, possibly you have had some difficulty with a dynamo, something that has baffled you for a long time and that you sat up alongside of that machine for nights to try and find, and at last when you did find it, it was so simple you felt half ashamed of yourself for not having discovered it sooner. But do you not think that an account of the trouble with the method you adopted in your search might be just what some one else wanted? Or perhaps you have been successful in your method of lighting some hall, lodge room or church. I will give just one illustration of this. Some two or three years ago some one wrote for a leading electrical journal a short account of a method he had successfully employed in lighting a lodge room for a secret society. The article barely filled a column of the paper. Some time later I was called on for estimates for lighting a new lodge room for such a society. I remembered the article and, referring back to it, used many of the writer's ideas. A fairly vigorous canvass was necessary to get the scheme through in its entirety, and I was greatly aided in it by taking the number of the periodical and pointing out that what I was recommending was what had been found satisfactory elsewhere. I mention this because I believe many would have thought the ideas in that article much too simple and self-evident to be worth publishing. I am sure that I voice the sentiments of a large number when I say that I wish more of those simple ideas appeared in our technical journals, and I know they would be willingly published if contributed. I spoke of your being asked to present papers. Do not stop to be drummed up and asked. When you come across something of interest make a note of it and write it out simply and plainly and send it in.

The appreciation of the address was evidenced by hearty applause.

Mr. Hamilton: I feel that we owe thanks to our president for his interesting and able address. There is so much suggested by it that it is hard to deal with it in a fitting manner. The principal suggestion is perhaps that bearing on the preparation of papers. Most of us feel that the writing of a paper is a hard task, but we must feel encouraged by his remarks. While on my feet I would like to say, in reference to this our first meeting, that it is unfortunate that the elements are against us, but the attendance is encouraging, and I trust this will be the foundation of larger and better meetings in the future. Exchange of ideas at first is hard, but as we get to know each other it will become easier. Speaking of the class of papers as mentioned by the president where chasing the wily X is indulged in, they are valuable for reference, but the discussions they invoke are both useful and interesting. I feel that it is not my province to make any further remarks, but again wish to express my appreciation of the president's address.

Mr. P. R. Colpitt: I feel diffident about speaking of papers after Mr. Hamilton, as he has prepared a paper, while I, though invited to contribute one, did not, but I heartily second all his remarks. I beg to move the

acceptance of the president's address with the thanks of the meeting.

Mr. Daley: I have much pleasure in seconding that motion.

The motion was put by the secretary and carried.

The president then thanked them for the vote of thanks.

Mr. J. A. Young said he was very glad to have the opportunity of listening to the address. This was the first meeting he had attended, and he thought the suggestion of getting to know each other was a good one. "I am away down in Sydney, and it is hard to get any one to talk to," he said. Referring to the president's remarks regarding poles, he stated that he would probably have to erect eight or nine miles of pole line shortly, and though he had already erected some fifteen or twenty miles, he did not possess all the information he required, and by such meetings as this one could acquire many valuable pointers.

Mr. Daley then brought forward a letter just received from his town council calling upon him to execute a bond of indemnity against any damages the town might be liable for, through his poles and wires being in the streets, and desired to know the experience of other members in this matter.

Some discussion took place, during which it was shown that if a company was possessed of a proper charter this matter was thoroughly provided for without a bond.

Mr. Nash: As this is an experience meeting, I would like to give one. I noticed some time ago that there was a lot of hot air over my boiler, which was serving no useful purpose, and it occurred to me that it would be a good plan to obtain a blower and introduce this air under the grate bars, but my directors failed to see the point. On New Year's day we had a terrible wind-storm and our chimney was suddenly reduced in height from 60 to 25 feet. I immediately telegraphed to Boston for a blower. When it arrived I belted it to the engine, ran a pipe to the grate bars, and have been happy ever since. Our income has increased about \$300, and the coal consumption remains the same, so that I think the blower has paid for itself. I have figured that the blower has increased my capacity about 10%, and can often get over the peak of the load with one boiler, while before I always had to use two.

The president said he was glad Mr. Nash had brought up this matter, as it was the kind of discussion that was needed. Continuing, he said the question of forced draft had lately been growing in importance. It is a question with most of us, he said, between putting up an iron stack every three or four years or expending a large sum on a brick one. Iron stacks do not last with us as they do in the western provinces, owing to the greater corrosion caused by the dampness of the atmosphere. This was an illustration of the benefit of our local association, as it gave an opportunity to discuss a question that would never have come up in an association holding its meetings farther west.

Mr. Chambers said he hardly expected to speak on the question of forced draught, but he had studied it considerably of late, and thought that some of its advantages were over-rated; nevertheless, he expected to install shortly a blower in his own plant. There was another matter that might be mentioned, viz., that of the automatic stoker. He thought much of the advantage claimed for that was due to the improved draught.

Mr. Freeman stated that Mr. Nash's plant was under a hill and his natural draft was at times poor.

Mr. Nash explained that he had a gate in the outlet which regulated the flow of air, and when the gate was entirely closed the belt of the blower ran very slack, showing that very little power was being used.

Mr. Colpitt said that in a Sturtevant blower, when the outlet was closed, the whole body of air in the blower was in motion and called for comparatively little power to keep it moving, whereas as soon as the valve was opened, and the air in the blower forced out, fresh air entered at the centre and had to be put in motion, calling for an expenditure of energy. In reply to a

question of the president, Mr. Nash stated that he used Cape Breton slack coal.

Mr. Daley asked for the experiences of any of the members who were using jet condensers.

Mr. Chambers said that in plants of over 80 horse power and with water cheap, it would pay to install a condenser. His own plant had a capacity of 300 horse power and the saving was enormous, but in 60 or 80 horse power it hardly paid for the trouble and expense of installation.

Mr. Nash: Another question I would like to ask is, what is the advantage of insulation on the conductors of long distance transmission lines at high potential? I am about to utilize a water power and will have a transmission line of some eight or nine miles.

In the discussion that followed attention was drawn to the fact that all the great transmission plants, such as those at Montreal and Niagara Falls, used bare wire exclusively. It seemed to be the unanimous opinion of the members that covering on a wire carrying over 2,000 volts was largely a snare and a delusion.

The president mentioned that Capt. Brophy, of the American underwriters, condemned the use of a covering on high potential wires. After some further discussion it was decided to finish the business at the morning session, doing away with the afternoon meeting, as several of the members were anxious to get away.

The question of time and place of next meeting was then taken up. It was moved by Mr. E. T. Freeman, seconded by Mr. S. G. Chambers, that the next meeting be held at Halifax some time in January. Carried.

The president then introduced Mr. F. A. Hamilton, who read a paper on "Electric Gong Buoys," which is printed elsewhere.

The president remarked that the paper was singularly appropriate for the first meeting of a maritime association. The question of signalling in foggy weather had been very much in evidence in the technical journals during the last few months, owing to the loss of the French liner *La Bourgoyne*, and other recent accidents at sea.

Mr. Chambers: I have listened with great pleasure to Mr. Hamilton's paper, but I think we all would have enjoyed it more had we been able to have gone from here to the steamer for the excursion as originally proposed, and seen for ourselves the need for such a system of signalling. I have much pleasure in moving a vote of thanks to Mr. Hamilton for his interesting paper.

Mr. Daley seconded the motion, which was carried unanimously.

The president then conveyed the thanks of the meeting to Mr. Hamilton for his able paper.

Mr. Hamilton, in reply, requested permission to read a letter which he had received from Mr. W. H. Preece, of the English post office, in which he expressed his approval of the system, but suggested the use of alternating currents, thus doing away with the use of springs, which would be apt to stick.

Mr. Chambers: Is there a way of producing a noise at a distance by electricity, other than by a bell, that would be suitable for a fire alarm?

Mr. Hamilton: That opens up a wide field. A motor could be used to drive an air compressor which could store the compressed air in a chamber, and thus be utilized to blow a whistle.

Mr. Chambers: That has been tried in the States, but the air leaked out, and when the alarm was wanted it would not work.

Mr. Colpitt thought that the buoy would be too small to contain the mechanism necessary to ring a bell of sufficient size to be heard any distance.

Mr. Hamilton explained that a small bell could be heard a long distance to leeward, and his idea was to get the buoys far enough out so that a vessel could always run to leeward of them without coming in dangerous proximity to the coast. The bell would be placed high up on the mast and the other mechanism low down in the buoy to counterbalance the bell.

Mr. Daley then moved, seconded by Mr. Anderson, that this convention do now adjourn. Carried.

COST OF COPPER FOR TRANSMISSION CIRCUITS.

THE accompanying diagram, showing the cost of copper for transmission circuits, was prepared by Mr. Chas. F. Scott, electrical engineer of the Westinghouse Electric Manufacturing Company, and embodied in a paper on "Electricity in Paper Making," read before the American Paper and Pulp Association. The curves enable one to find the cost of copper for transmission circuits with any given percentage of line loss, the distance in feet or miles, and the voltage, and will no doubt be found useful.

Mr. Scott's paper explained in a brief and simple manner many of the characteristics of electricity and electrical apparatus, and showed in what way and under what conditions they might be profitably employed in the paper-making industry. His conclusions as to the efficiency of electrical apparatus are given in the following words:

"The full load efficiency of generators, both of direct current and alternating current, varies with the size and type, but for machines of 100 horse power and over

cent. in sizes from 5 to 100 horse power, and is 90 per cent. to 96 per cent. for larger sizes. Efficiency of transmission lines and distributing circuits depends upon the E.M.F., the amount of copper and upon the cost. The approximate efficiency of a transmission plant will therefore be between limits about as follows:

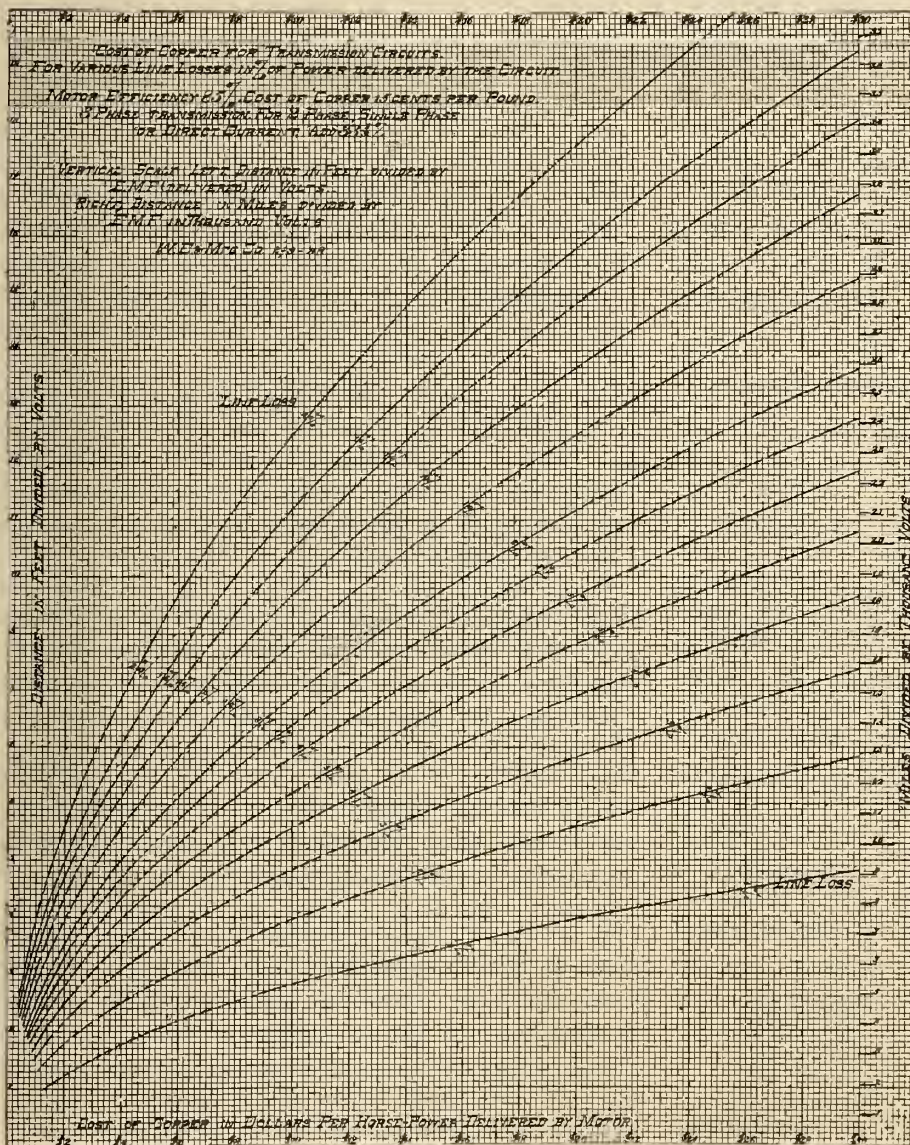
Generators.....	90 to 96%
Raising transformers.....	96 " 98 "
Transmission line.....	90 " 95 "
Lowering transformers.....	96 " 98 "
Local wiring.....	97 " 99 "
Motors.....	85 " 96 "
Efficiency of plant.....	61 " 83 "

"In local distribution from low voltage generators the losses in raising and lowering transformers are of course eliminated, and the range of efficiency becomes 66 per cent. to 86 per cent."

THE BULLIER CALCIUM CARBIDE PATENT CANCELLED.

THE Berlin Patent Amt has nullified Bullier's calcium carbide patent, and in view of the constantly growing

importance of acetylene, it is worth while to review the facts of the case. Bullier was Moissan's special demonstrator, and the patent was granted in 1894 for the only practical process of producing calcium carbide in the electric furnace. This German patent of the French chemist becomes the property of the Neuhausen Aluminium Company, and as they made difficulties over granting licenses it was a stumbling block in the way of the development of the acetylene industry in Germany. Hence, now that it is swept out of the way, carbide will quickly become cheap in the fatherland. As a matter of fact, it is astonishing that the German patent was ever granted, or that the Frenchman Bullier should have claimed the invention. Wilson, an American, obtained English and American patents in 1893 for the production of calcium carbide exactly in the same manner, and even his patents were not now unassailable, seeing that a German chemist, Professor Borchers, had made the first communication of the method of producing calcium carbide ten years be-

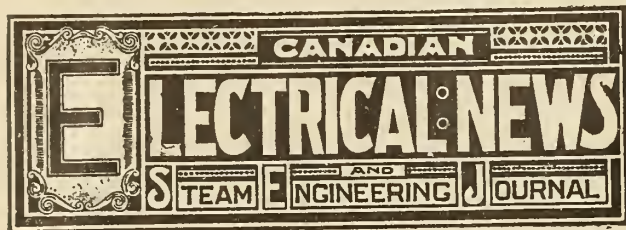


CURVES SHOWING COST OF COPPER FOR TRANSMISSION CIRCUITS.

the variation may be from 90 or 91 per cent. to 95 or 96 per cent. The efficiency of alternating current transformers, in the same way, may be said to vary from 96 or 97 per cent. in sizes less than 100 horse power and 97 or 98 per cent. in larger sizes. The efficiency of motors both for direct current and alternating current varies from 80 or 85 per cent. to 90 per

fore. The German Patent Amt accorded the patent to Bullier for crystallized carbide, but Lord Kelvin affirms that the calcium carbide sent to him by Wilson in 1892 was in perfect crystals.—Invention.

"I find THE NEWS very interesting and instructive, and I don't intend to be without it."—Mr. H. Large, Guelph, Ont.



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Short-Sighted Methods.

FROM information to hand, we are of the opinion that the movement in favor of municipal control of electric lighting is being advanced by the unpopular methods of some of the private lighting companies. In quite a number of instances these companies have not pursued a business policy calculated to satisfy their customers and enable them to retain their business. They have acted on the principle, and, in fact, have in some instances been foolish enough to assert, that the customers must take light under whatever conditions and terms the company might see fit to impose. Such companies have not attempted to keep their plant in an up-to-date condition, but have endeavored to run their business with as little outlay for apparatus and operating expenses as possible. As might easily have been foreseen, the result of this line of policy has been forfeit of the sympathy and goodwill of the consumers on whom the success of the business must depend, and the dissatisfaction thus engendered has, in many instances, taken the form of active opposition and advocacy of municipal control. Electric lighting companies must recognize the fact that they are in identically the same position as the proprietors of stores and other enterprises which depend for their success on the extent to which they cater to public requirements, and they must not seek to avoid any reasonable amount of trouble to give satisfactory service to their customers. Their object should be to please by every means the persons from whom their business derives its revenue. It will be found to be good policy for the manager of the company to frequently drop in on his customers and learn whether they have any complaints to make regarding the character of the service.

Specifications for Electric Plants.

At the present time, when several municipalities are considering the advisability of installing electric light plants, the question of having proper specifications on which to tender is one of much importance to manufacturers of electrical apparatus. It is, of course, preferable to have specifications prepared by a competent and unbiased electrical engineer, in order that all tenderers may be placed on the same footing, and that the municipality may obtain the best apparatus for the money invested. But where such an engineer is not employed, it becomes the duty of the official deputed to draw up the specifications to obtain as much information as possible on the subject. As our readers know, the city of London, Ont., recently invited tenders for an arc plant, upon specifications prepared by the city engineer. Exception was taken to these specifications by at least one company, on the ground that they were such as to exclude some manufacturers of electrical apparatus from tendering. While in some respects the specifications could have been amended with advantage, we are of the opinion that on the whole they gave quite general satisfaction, as will be seen by reference to a number of letters from interested persons, printed elsewhere in this issue. These letters will, we believe, serve a useful purpose, inasmuch as they show the prevailing opinion with regard to the conditions which should be embodied in specifications of this character. It is regarded as a mistake, so far as the purchaser is concerned, to place such restrictions on tenderers as will shut out good apparatus and limit the field for competition. A greater error is to specify a certain make of apparatus, thus permitting the manufacturer of same to fix his own

price for the goods. This was the mistake, and about the only serious one, committed by the city engineer of London. By specifying the Adams-Bagnell single carbon lamp, he excluded the manufacturers of all other lamps from tendering, and gave the Adams-Bagnell people the contract at any price they wished to name.

ALTHOUGH it is only a few years since Canadian Materials. the first electric railway was built in Canada, it is now possible to obtain in this country all the materials necessary for the complete equipment of an electric road. In the case of the street railway recently completed at St. Thomas, Ont., we observe with pleasure that, with the exception of the overhead joists and fixtures, the line was built and equipped with Canadian material, the total cost being \$85,000. The rails were made at Hamilton, Ont.; the engines at Amherst, N. S.; dynamos and electrical equipment at Peterboro', Ont., and the cars at Ottawa. We would gladly welcome more examples of this character, as upon the building up of our industries depends the future of the Dominion of Canada.

THE Maritime Electrical Association is to be congratulated, as a new organization, upon the steps which have been taken to establish the foundation of a useful society. It is true that unless other than social advantages are to result from the formation of such associations, their existence is likely to be of short duration. This is fully recognized by the members of the Maritime Electrical Association, the proceedings of the first meeting of which are printed in this issue. Associations of this character permit of the discussion of questions having a local bearing which, even if taken up by a Dominion association, would interest but a comparatively small percentage of the members. In Canada, perhaps more than in other countries, owing to its vast territory, there exists the necessity for local organizations, and we therefore predict a reasonable measure of success for the association in question. We have no fear that the interests of the Canadian Electrical Association will be likely to suffer as the result of the formation of local organizations of this character; on the contrary, they should be a source of strength to the more important body. In the presidential address of Mr. Bowman are found many suggestions by which the members should profit. The practical experiences related by the members are likewise instructive. May the association extend in membership and usefulness.

SOME of the electrical companies are pursuing a "penny wise and pound foolish" policy with regard to the efficient operation of their plant. It would seem to require but little argument to show that machinery which has cost many thousands of dollars should not be entrusted to the care of an incompetent operative, yet we find managers of companies seeking to save money by cutting down the wages of operatives to a point which must result in bringing them only the services of incompetent men. An instance of this kind came to our notice recently, in which the owners of an electric light plant were compelled to replace two 100 horse power boilers and a 75 horse power engine, which had been rendered useless by lack of knowledge and carelessness

on the part of the engineer in charge. The boilers, which had only been a short time in use, had rarely, if ever, been cleaned, and contained deposits of mud which resulted in the shell being burned and the boilers rendered unsafe. A high speed engine had been racked to pieces and the usefulness of a more valuable one so impaired as to render it unfit for the required service. After all this damage had been done and a loss of many thousands of dollars incurred, the manager of the company began to look around for a competent engineer. When told that he would have to pay at least \$65 per month for an efficient man he said, "Why, that is \$30 per month more than we have been accustomed to pay." Notwithstanding, he at last came to a realization of the fact that to double the engineer's salary might, after all, be the means of affecting a saving in operating expenses, and it is the purpose with the new machinery to install a man competent to properly operate and care for it.

Steam vs. Electric Railways.

IT is admitted by the management of steam railways that great inroads are being made upon their local passenger business by electric railways. The latter are steadily spreading out, and it is difficult to say to what extent they will become competitors to long distance roads. The fact is recognized that there are obstacles to be overcome in connection with the economical operation of electric railways in rural municipalities. In ten years up to and including 1893, the number of passengers carried on the steam railroads in the state of Massachusetts increased at the rate of 5,825,000 a year. The next four years they decreased at the rate of 4,766,000 a year, owing to competition from electric roads, as in these same four years the number of passengers carried by electric railways that enter Boston increased over 31 per cent. The experience of railroads in the vicinity of Chicago and other cities is identical in this particular. If steam railroads are to compete successfully with electric systems, it will be necessary to give cheaper fares and greater attention to the comfort of passengers. Uncleanliness is one of the greatest objections that can be urged against the steam road. But it is not alone the passenger traffic that has been and will be affected. The electric roads are now reaching out, with some success, for freight business. In this connection we observe that a successful test of the Bonner rail wagon, as described in a paper by Mr. W. T. Bonner, read at the last convention of the Canadian Electrical Association, was made recently at Toledo, Ohio. The purpose of this wagon is to convey farm produce to market, its construction being such as to permit of the wagon being separated from the truck and transported on the electric railway to point of destination. Should this scheme work out satisfactorily, as some believe it is likely to do, the field for the electric railway will be greatly broadened.

The amalgamation has taken place since our last issue of the Westinghouse Electric and Manufacturing Company, of Pittsburgh, Pa., and the Walker Company, of Cleveland, Ohio, two of the leading electrical concerns in the United States. This is regarded as one of the most important transactions that has been recorded for some time, inasmuch as, besides making a particularly strong combination, it puts an end to litigation affecting Walker apparatus. By the change the Walker Company is brought under the terms of the agreement which has existed for two and one-half years between the General Electric and Westinghouse companies. In a few years the Walker Company have built up an extensive business, and we are glad to learn that their factories are to be continued.

AN ALTERNATING CYCLE-CURVE RECORDER.

BY PROF. H. L. CALLENDAR, M.A., F.R.S.

THE study of alternating current phenomena by means of the delineation of the curves, which represent the mode of variation of the pressure and current throughout the cycle, has been rendered so familiar by the labors of Hopkinson, Ryan, Fleming, and many other observers, that no apology is needed for introducing a new piece of apparatus intended to reduce the labor involved in this method of investigation. Briefly stated, the function of the Cycle-Curve Recorder is to describe automatically, without any interference on the part of the observer, a continuous pen and ink curve representing the cyclical variation of the quantity to be recorded. The immediate object of its construction was the study of the variations of the form of the current or pressure cycle-curves of a particular form of alternator with variations in the character of the load on the station at different times in the day. The labor involved in this study by any of the usual means was such as to be prohibitive. The action of the present apparatus, however, is so completely automatic that it can be set to record the form of the cycle-curve every half hour throughout the day, and may then be locked up and left to itself, to continue recording for so long a period as may be desired. The complete carrying out of this programme was unfortunately interrupted by my appointment to the chair of physics at University College, London, and it is now unlikely that I shall have leisure to pursue the investigation myself; sufficient, however, has already been accomplished to show that the apparatus is capable of very accurate work, and is likely to prove a labor-saving device of considerable utility.

The apparatus consists essentially of a recording potentiometer working in conjunction with a cycle contact maker, which selects the P. D. to be recorded from a particular point of the cycle in the usual manner. By means of a simple worm gearing, the contact brushes are slowly revolved, and the point of the cycle selected is continuously varied concurrently with the motion of the record sheet, so that the variations of the P.D. throughout the cycle are recorded in the form of a continuous curve. The recording pen is of the usual pattern, and is directly attached to the sliding contact of a delicate relay on the potentiometer bridge wire. This relay is made to actuate a pair of motors in such a manner as to keep the sliding contact always at the balance point. The drum on which the record sheet is wound may be of the ordinary kind, revolving once in an hour, but if continuous records of the forms of the cycle are required, extending over a longer period without changing the sheet, it is necessary to replace the simple drum by a continuous band. The width of the sheet, which limits the scale of the record, has hitherto been about 8 inches, which is found to give a sufficiently open scale for most practical purposes.

THE RECORDING POTENTIOMETER.—The recording potentiometer was not originally designed for this particular purpose. I had, as a matter of fact, previously applied it to a great variety of other uses, such as the recording of variations of voltage, current, power, resistance, temperature, pressure, etc. The idea of making a potentiometer or Wheatstone bridge record its balance point automatically, in the manner described, is a very obvious one. I first endeavored to carry it into practice when working with platinum thermometers at the

Cavendish laboratory in 1886. With this object I selected the most delicate polarized relay that I could find in the apparatus room, and connected it up in the place of the galvanometer in my apparatus. I very soon found that in order to record temperatures successfully to the tenth of a degree, I should require a relay about a thousand times more delicate than the best of the post office pattern. After making several other experimental relays with selenium cells, etc., I gave up the attempt for the time, and did not return to the subject till the conclusion of the McGill College session in April, 1897. I then succeeded in constructing a sufficiently delicate relay, and in obtaining records of temperature in pen and ink, on a scale as large as 1 cm. to the degree Fahrenheit. Several of these early temperature and volt records were exhibited at the meeting of the Canadian Royal Society on June 23rd, 1897, and some of them have been reproduced in the Canadian Royal Transactions for that date. The apparatus itself has been recently exhibited at the conversazione of the Royal Society in London, and on other occasions in Canada, where the first instruments were constructed. It is hoped that an improved pattern, as made by the Instrument Co., Cambridge, may be exhibited at the forthcoming meeting of the British Association at Bristol, and that a description of the final form may then be published. In the meantime it may be of interest to describe the cycle contact-maker, and to give some account of the special difficulties which were encountered in connection with this particular application of the recorder.

THE CYCLE CONTACT-MAKER.—The idea of applying the instrument in conjunction with a suitable cycle contact-maker for the recording of cycle curves automatically, first occurred to me in connection with the investigation of the form of steam temperature cycles in the cylinder of a steam engine by means of a very sensitive platinum thermometer, as described in a paper by Prof. Nicolson and myself, "On the Law of Condensation of Steam," which was read and discussed at a meeting of the Institution of Civil Engineers in November, 1897, and has since been published in their Proceedings, Vol. CXXXI. The application to alternating current cycles followed as a matter of course, being, in fact, very much the simpler application of the two. The method of obtaining a continuous record by means of a continuous motion of the cyclical contact point in unison with the record sheet or plate, was employed by Blondel (*The Electrician*, Vol. XXVII, p. 603), who made use of a spot of light reflected from a dead-beat galvanometer on to a slowly moving photographic plate, the deflection of the galvanometer being proportional to the instantaneous value of the P.D. or current to be recorded. The objection to the method above sketched, apart from the fact that it gives a photographic and not a pen and ink record, is principally that it is a deflection method and not a null method. In the present instance, in addition to the usual objections to a deflection method, there is the difficulty of the variable resistance of the cycle contact in the galvanometer circuit. In the null method, with the potentiometer, changes in the contact resistance are immaterial, and there are no errors introduced by inequality of scale, or hysteresis of the suspension.

THE SYNCHRONOUS MOTOR.—When completing the equipment of the McDonald Physics Building in 1893, for the application of the cycle-curve method to the study of alternating current phenomena, I ordered a small laboratory alternator of the Pyke and Harris pat-

tern, mounted on a bed-plate with a suitable continuous current motor. My reason for choosing this particular type of machine, with its overhung spider carrying the revolving keepers, was that it could be fitted with a cycle contact in a very simple manner, and could be used, either as a generator or as a synchronous motor, for delineating cycle curves of larger generators. The cycle contact brushes consisted of a pair of fine steel springs mounted side by side on a short projecting arm carried by a divided circle centred on the circular face of the field magnet, which was concentric with the shaft. The ends of the springs rested on the edge of an ebonite disc turned in position on the shaft, into the circumference of which were fitted, at intervals of a complete period, a number of narrow contact pieces of steel, each about one-hundredth of a cycle in width. This form of contact was found to wear very well and to give excellent results, provided that the disc was clean and running perfectly true. The performance of the contact was tested by taking curves, first by the potentiometer balance method, and then by the deflection method under the same conditions. In the second case, any variation in the contact resistance would be made evident by an unsteadiness of the galvanometer. The results compared very favorably so long as the resistance of the galvanometer was made as high as possible, but even in this case it was obvious that the potentiometer method was greatly to be preferred. I, therefore, abandoned the attempt to fit up an automatic recording apparatus of the Blondel type, as I had at first intended, and did not return to the question of obtaining automatic records, until the completion of the recording potentiometer at a later date appeared to offer a more convenient and accurate solution of the problem.

On making the first experiments with the recording potentiometer, I found, as I had anticipated, that the resistance of the cyclical contact was a matter of considerable importance. In order to secure the maximum sensitiveness for small differences of potential, it was necessary to make the resistance of the relay or galvanometer of the order of 10 ohms. Under these circumstances it was evident that any imperfection of the contact, although it would have no effect on the position of the balance point on the potentiometer bridge-wire directly, would reduce the sensitiveness of the relay, and thus make the position of the pen lag behind the correct reading, owing to want of quickness in following. With the object of reducing the resistance of the contact, the width of the strips in the circumference of the ebonite disc was increased, and they were made to project slightly and slope back at an angle with the edge of the disc, so as to maintain the contact as long as possible. It was found, however, that with the 9 in. contact disc originally fitted on this machine, the peripheral velocity was too great for this form of contact, and the brushes had a tendency to jump and break, especially at high speeds. To get over the difficulty of the peripheral velocity, without abandoning the steel spring contact, a small fan motor of a common type was fitted with a synchronising rotor, and an ebonite contact disc of 1 in. diameter. This was fitted with an oil pad to keep the contact clean, and gave very fair results up to speeds of 60 or 80 cycles per second. It would no doubt be possible to make some better form of contact for the purpose, but, as the small motor worked fairly well, and the time at my disposal was

limited, I did not think it worth while to make any more experiments in this direction at the time.

The drum on which the record was taken in the potentiometer was made to revolve once an hour by means of an ordinary clock contained in the barrel. The simultaneous revolution of the contact brushes might have been very simply secured by means of a similar clock. But in order to secure sufficient power, and to avoid any possibility of slipping, it seemed preferable to obtain the motion from the spindle of the motor itself by means of worm gearing. It might appear at first sight that this would lead to a certain loss of accuracy, as the interval on the drum corresponding to the wave length of the cycle would vary with the speed of the motor. In reality, however, the accuracy of the record is, in any case, limited by the constancy of speed and voltage of the generator. The contact springs were mounted on an ebonite arm on the face of a worm wheel capable of turning freely on a boss concentric with the shaft of the motor. The tangent worm was driven by another worm wheel, the worm of which was driven by a large pulley belted with an India rubber band to a small pulley on the shaft. Each of the worm wheels had 100 teeth, and the ratio of reduction could be varied by varying the ratio of the pulleys. In the records here reproduced, the speed of revolution of the contact springs was adjusted to be about 20 min. to the half wave, as this happened to give the best proportions to the curve with the drum revolving once an hour, and a scale of 1 in. to 50 volts on the record. The small synchronous motor, fitted in this manner with a slowly-revolving cycle contact, was complete in itself, and proved to be extremely convenient and portable, the whole weighing only 10 or 15 lbs. It was generally brought up to speed when starting by means of a small direct-current motor, but a hand wheel and belt would probably be in many cases more convenient. Such faults as it was found to possess were not inherent in the method or design, but were due to the cheapness of the machine and the roughness of the workmanship. The poles and clearance were unsymmetrical, the rotor badly balanced, and there was too much friction and slack in the bearings and brushes, faults which might naturally be expected in a cheap commercial motor hastily adapted, but which could be easily remedied in making a special instrument for the purpose. The curves here reproduced, which were taken with the first rough experimental apparatus, must not, therefore, be regarded as a fair test of the capabilities of the method. And when we consider that the curves, in addition to the mechanical defects of the motor, include all the variations of speed and voltage of the supply company, it seems likely that the accuracy of the apparatus under favorable conditions will be limited only by the scale of the record, and the fineness of the line traced by the pen. The current cycle curve of the small motor itself is much the most irregular. This might naturally be expected, and is probably to be explained by variation of the friction, which would necessitate variation in the torque and in the angle of lag of the rotor. The majority of the irregularities are, however, too small to show clearly when reduced to half the original scale. This is very creditable to the steadiness of the voltage and speed of the Royal Electric Supply Company.

DESCRIPTION OF THE CURVES.—The first pair of curves are of a familiar type, representing the volt and current

cycles on the primary of a 5 h.p. transformer with a closed magnetic circuit, when working at a very low magnetic induction with no load on the secondary. The experimental transformer was not connected directly to the primary mains of the Royal Electric Co., but to the 100 volt side of the lighting circuit transformer, which was otherwise unloaded. The volt and current cycles were not taken simultaneously, but on successive days. The correct relative lag of the current curve is readily obtained on the record sheet, by setting the worm wheel carrying the contact springs at the zero mark, and putting the worm in gear at the moment when the pen reaches the zero line on the drum. The scale of amperes is placed on the right of the figure in each case corresponding to the ampere curve marked (a); the scale of volts is placed on the left and corresponds to the curve of volts marked (v). The scale of the bridgewire was adjusted in the present case to be 2 in. to the volt. The current to be delineated was passed through a non-inductive resistance of one ohm, so that the scale of the record was 2 in. to the ampere. For the volt curve, one-hundredth part of the voltage was taken by means of a ratio box. The scale was, therefore, 2 in. to 100 volts. The horizontal time scale in each case simply marks the speed of revolution of the record sheet on the drum. The length of a wave on this scale depends on the time required by the contact springs to turn through the interval corresponding to a cycle. This was determined by the speed of the motor, and by the ratio of the reducing gear. It would not have been difficult either to drive the recording drum from the motor, or to drive the contact springs by clockwork, in both of which cases the wave length on the record would have been constant. It would probably be more interesting, however, at least in view of the possibility of taking all day records in this manner, to have the variations of speed recorded by the variations of wave-length. The forms of the curves given in Fig. 1 were verified indirectly by comparison with curves taken off the same transformer under conditions as nearly similar as possible, by the potentiometer method, with a sensitive galvanometer in place of the relay and automatic recorder, and using the Pyke and Harris alternator as a synchronous motor. They were also verified by describing the hysteresis loop in each case, and comparing it with the results of ballistic tests. It was apparent that the results given by the automatic recorder were at least as accurate as those obtained by the much more laborious method of eye observations and subsequent plotting.

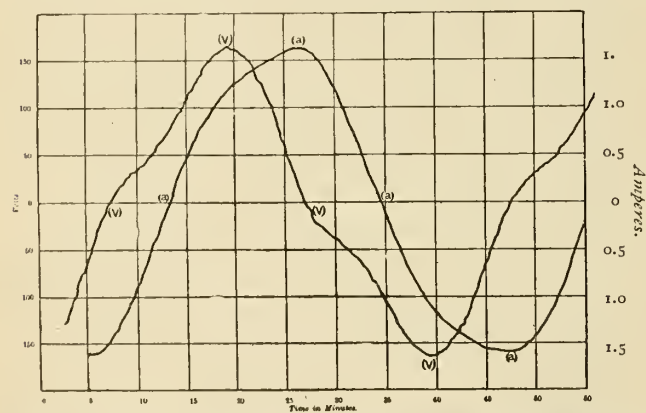


FIG. 1. (a) Automatic Record of Current Cycle, on Primary of Unloaded Transformer. (v) Automatic Record of Volt-Cycle of Stanley Alternators of the Royal Electric Co., Montreal. Taken by Synchronous Motor at the McDonald Physics Building, one mile distant. Speed, 65 Cycles per Second.

The pair of curves exhibited in Fig. 2 were taken on

the same record sheet about the same time of day. The volt curve is practically a repetition of the previous volt curve. At other times in the day, under different conditions of load on the supply station, the form of this curve was found to be considerably modified. The inequalities of the curve, which are seen to be most conspicuous near the vertex of the wave, were in all probability chiefly due to variations of speed and voltage at the station. The current curve in Fig. 2 is the current curve of the small synchronous motor itself, and was located on the record sheet, as previously ex-

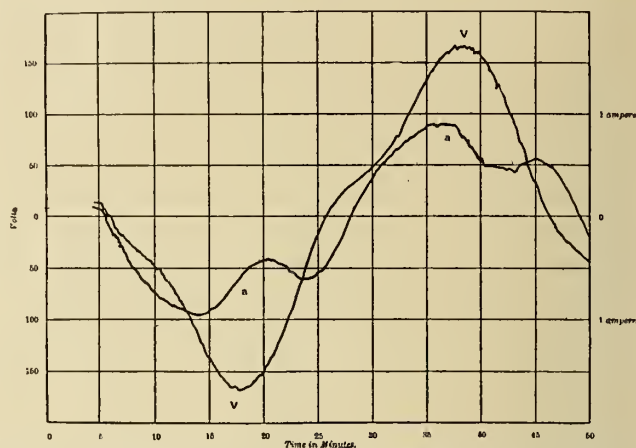


FIG. 2.—Automatic Record of Volt and Current Cycles on small Synchronous Motor with Unsymmetrical Slot in Pole Pieces. The minute irregularities of curve are due to variations of speed and voltage of supply. Connected to the mains of the Royal Electric Co. Record taken at the McDonald Physics Building, McGill College, Montreal.

plained, as nearly as possible, in its true phase-relation to the volt curve. The load on the motor was largely due to eddy currents and hysteresis, in addition to mechanical friction. The mechanical friction was certainly variable, and the load due to eddy currents would diminish as the motor became heated. The curve shows a curious want of symmetry, which is no doubt partly to be explained by these causes, and partly by the want of symmetry of the construction of the motor itself. The dip in the crest of each wave is due to an unsymmetrical slot in each of the poles of the motor. These slots were occupied, in its original state, as a synchronous induction motor, by copper plates, partially shading the poles, the function of which was to give sufficient starting torque to the squirrel-cage armature, when used as a fan motor. The other irregularities of the curve are such as might naturally have been expected under the conditions described. The curve itself is of no value except as an illustration of the performance of the recorder. It is quite possible, however, that a study of similar curves, obtained from motors under different conditions of load and supply, might give valuable information with regard to the best conditions of working and the best methods of construction.

The pair of curves exhibited in Fig. 3 are not cycle curves, but are given as an illustration of the sensitiveness of the recorder and of the different uses to which the same instrument may be put. The change from one kind of record to the other is effected by changing the scale of the bridge-wire, by substituting a different wire and unplugging suitable resistance coils. In the curve Fig. 3 (a), representing the discharge of a small storage cell through a constant resistance, the scale of P.D. on the bridge-wire of the recorder was only 1 millivolt per inch, the record being intended as a test of the delicacy of the instrument. The P.D. to be recorded was taken from the potential terminals of a standard resistance of one-thousandth of an ohm,

through which the current was passed. The scale of the record was therefore 1 in. to the ampere. The resistance of the bridge-wire had been adjusted to be one-twentieth of an ohm per inch by means of a suitable shunt, and the current through it was adjusted to be 20 milliamperes by means of an adjustable resistance and a standard cell. The smoothness and steadiness of the record obtained under these conditions were very satisfactory, considering that the power expended on the shunt was only one-fortieth of a watt, at a current of 5 amperes. As compared with the more common types of recording ammeters it will be observed that the resistance of the shunt required is extremely low. The scale, moreover, is exactly one of equal parts, and the co-ordinates of the record are rectangular, as the pen is moved along a straight slide instead of describing a circular arc. The same recording instrument and scale can also be used for any range, from 20 milliamperes to 20,000 amperes, by connecting it to different shunts of suitable magnitude in each case.

The record shown in Fig. 3 (b) affords an even more severe test of the capabilities of the recorder. The current for the bridge wire in this case was taken off the power circuit, and was adjusted to be 30 milliamperes at 550 volts, so that the scale of the bridge-wire

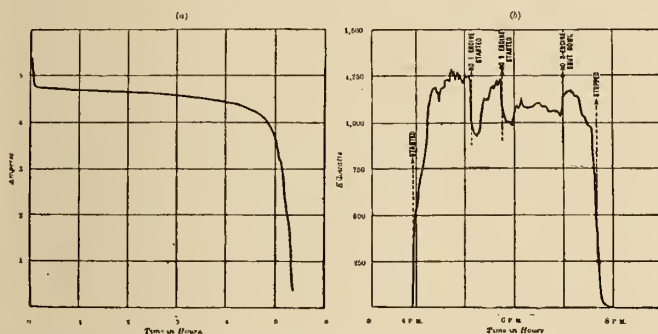


FIG. 3.—(a) Discharge Curve of a Small Storage Cell. (b) Record of Load on 1,500 Kilowatt Generator of the Montreal Street Railway Co., taken at the Power House. Note changes of load due to starting and stopping other engines. These two curves were taken on the same instrument, changing only the shunt.

was 2 in. to three millivolts. The P.D. to be recorded was taken off a low resistance shunt in the circuit of the large 1,500 kilowatt generator of the Montreal Street Railway. The shunt was one of very low resistance, so that the P.D. to be recorded on the bridge-wire was only 3.30 millivolts for a circuit of 1,000 amperes through the shunt. The scale of the bridge-wire being 1 in. to 1.5 millivolts at 550 volts, and being made to vary directly as the volts, the record was obtained in watts, on a scale of 250 kilowatts to the inch. The P.D. on the bridge-wire in this case was slightly larger than in the previous instance, but the performance of the instrument was in reality more remarkable, because it was hanging on the wall of the power house, in close proximity to the large machines and engines, and was exposed to a great deal of vibration and other disturbance. The record itself presents some features of interest which may be briefly referred to. The large engine (No. 7) was started a little before 4 p.m., so as to be in time for the evening load, which reaches a maximum between 6 and 7 p.m. A load of about 1,000 amperes was switched on, and gradually increased to over 2,000 in the course of the next 10 minutes. Other engines were started in a similar manner about 5:10 and 5:45, as the main load increased. The starting of these engines had the effect of diminishing the load on the big generator temporarily, as shown on the record. Between 6 and 7 p.m. four engines of 1,000 h.p. each were running, in addition to

the big engine. One of these was shut down at 7 p.m., causing a temporary increase in the load on No. 7. About 7:30 p.m. the load on No. 7 was gradually reduced to 1,000 amperes, and it was cut out of circuit at 7:45 p.m., after which the reading of the record rapidly falls to 0. In power records of this kind, where the load is rapidly varying 10 or 20 per cent. up and down from second to second, it is necessary, in order to obtain a clear and legible curve, that the recording pen should automatically average these rapid fluctuations, a result which is readily secured with the present instrument by suitably limiting the rate at which the pen can follow a sudden change of load.

The foregoing illustrations do not by any means exhaust the possible limits of delicacy of the recording apparatus. It would be easy to make the relay much more sensitive, if required for special work. The present pattern is very simple, and is quite delicate enough for all ordinary purposes. For obtaining cycle records it is evidently impossible to work with so small a P.D. on the bridge-wire, as the galvanometer circuit is closed for a small fraction only of each cycle. For this reason a special bridge-wire was constructed of insulated wire wound in a fine screw thread on a brass rod in a manner similar to that commonly employed in rheostats for fine adjustments. The method of winding in a screw thread gives great regularity and uniformity almost equal to that of the plain wire. Brass is far preferable to hard rubber for accurate work, and there is no difficulty in obtaining sufficiently perfect insulation. The objection to the spiral is that the contact is not quite continuous, but in the present instance, the steps on the record due to the fine screw thread were much smaller than the irregularities due to variation in speed and voltage of the supply. For finer work, however, it might no doubt be preferable to use a straight continuous wire in conjunction with a more delicate form of relay.

The cycle records above reproduced were taken on one of my recording instruments by Mr. L. W. Gill, B.A.Sc., one of the research students at the McDonald Physics Building of McGill College, who also assisted me by making a spiral bridge-wire and parts of the small synchronous motor to my designs.—The Electrician.

The city of New Westminster, B.C., is resisting the proposal of a company to tap the water of the Coquitlan Lake, and develop electric power. The civic authorities believe that the city will require as a reservoir all the water supply over which it has a right.

The ELECTRICAL NEWS is indebted to the Royal Electric Company for a souvenir of the recent convention of the Canadian Electrical Association held in Montreal. It consists of a photograph, 15 by 20 inches in size, of the members and visitors to the convention, taken in front of the power house of the Chambly Manufacturing Company at Chambly, Que., in which, as our readers know, Royal Electric apparatus is installed.

A recent issue of the Electrical World contains a description of a new central station built by the Paris Compressed Air Company, of Paris, France, a concern which is engaged in electric lighting on an extensive scale. The general plan on which the lighting system of this company is laid out is one which has never come into use in Canada or the United States, being what is known as the five wire system, making use of an extension of the three wire principle. Current is generated at 500 volts, and distributed on two wire feeders to sub-station, wherein are storage batteries connected across the main, from which run five wire distribution systems, the pressure being equalized between the four ten-volt circuits of the distribution system in series with each other by means of batteries. In this way a great economy of copper is effected over the ordinary three wire system.

SPECIFICATIONS FOR THE LONDON ARC PLANT.

WE have received the following letters relative to the specifications prepared for the installation of an arc plant for the city of London, Ont.:

MONTREAL, Sept. 5th, 1898.

GENTLEMEN: Replying to your favor of August 30th, I would say that it appears to be a pretty fair specification to cover this class of plant. Any criticisms which I have to make would be confined to the question of the advisability of placing restrictions on the tenderers which, if lived up to, may shut out good apparatus. For this standard apparatus the tenderer will offer his standard sizes, and any restrictions as to speed, efficiency, heating, etc., will have no effect on the tenders made, but may be used to block out certain bids when the contract is let. It appears to be more advisable, where standard apparatus is required, to request each tenderer to state and guarantee what his apparatus is capable of doing in regard to heating, regulation, efficiency, insulations, etc.

I also notice that no break down test is specified, but the insulation is to be 259,000 ohms, a figure much too low for this apparatus; the test in any case being useless except as a precaution before applying the high voltage test.

Yours truly,

ROBERT A. ROSS, E. E.

ST. CATHARINES, ONT., Sept. 7th, 1898.

DEAR SIR,—We have looked over the specifications carefully and consider them very complete and a sufficient protection to the city. The only criticism we could make is that one particular style of arc lamp is mentioned under the heading of "Arc Lamps" in the first line of this article. There are probably several other lamps besides the Adams-Bagnell which would be equally as satisfactory and which could be obtained in Canada, whereas it would be necessary to import the Adams-Bagnell lamps at considerable expense. The size of dynamo and description would seem to indicate that the Brush 100 light machine was the one required. The specifications might have been broadened somewhat in this respect, though the wording is not such as to absolutely exclude other makes of dynamos.

Taken as a whole, the specifications are rather above the ordinary specifications met with in bidding on municipal plants, and aside from the items above mentioned contain no features which should exclude reputable manufacturers from bidding, while on the other hand the city appears to be amply protected, and should under such specifications obtain a very serviceable plant.

Yours very truly,

THE PACKARD ELECTRIC CO., Limited.

E. E. Cary, Manager.

MONTREAL, Sept. 3rd, 1898.

GENTLEMEN: Not being directly interested in the manufacture or sale of arc light apparatus, the question is not of sufficient importance for us to give as complete criticism as you might desire. We may say, however, that on going over same we rather think as a whole the specification is, from the point of view of the engineer, a very good one, except that one has but to read between the lines to see exactly what class of apparatus is aimed at.

Briefly, we consider the specifications on dynamos good. Guarantee on dynamos altogether too excessive, as we do not see why any manufacturer should be compelled to practically offer a blanket insurance on the whole plant against fire, water or lightning for one year. The specifications for testing instruments are all right, except that we doubt whether an instrument can be made that will stand being left in current at all times without altering the calibration.

Arc lamps. In this section we may say that the engineer has had sufficient confidence in himself to name the style of arc lamp desired. Here we consider he should stop, without asking for such a complete guarantee as "shall be free from hissing, flicking or flaming when provided with ordinary commercial standard carbons"; also, where does the limit come in for "no complicated clockwork mechanism"? Lamp guarantee is fair; hangers and hanging equipment all right, except that manilla rope is not satisfactory for the work required.

Switchboard apparatus is fair, with the exception that we do not see why he should put in the clause "with least possible danger to short circuit or error." Why not make it "with no possible danger."

Line construction is apparently all right. Not being acquainted with local conditions can make no comment.

Wire. This section is lengthy without striking the point. The wire is to be covered with a triple covering of insulated material. Question: What class of insulated material is required, dry mud or pure para rubber?

Acceptance of plant. We do not think it fair that such exacting specifications should be left in the hands of the city engineer or an electrical expert to be chosen by him, but rather that one should be named before, or mutually agreed upon. Finally, we would say that in our belief it is absolute folly in view of the present advanced state of the art, to install 9.6 ampere machines and open arc lamps for municipal arc lighting.

Yours respectfully,

JOHN FORMAN,

Per Geo. H. Hill.

PICTON, ONT., Sept. 19th, 1898.

DEAR SIR,—In your September number you publish copy of specifications for electric plant for city of London, and ask for the opinions of electrical men on the same. I am not a manufacturer, neither am I what you would call an electrical engineer, but am somewhat interested in electrical work, and I therefore offer the following short notes on the specifications:

The specifications are, I think, so far as the city of London is concerned, very complete, but they are a shade hard on certain manufacturers. The first, and about the most objectionable feature that strikes me, is the guarantee of the dynamo. The engineer says "the machine or machines must stand a sudden short circuit for a period of five minutes." Now, who ever saw a 100 light dynamo, 9½ amperes, about 75 horse power, that would stand a short circuit for five minutes and not burn up, and if the building was not fireproof it would surely set it on fire also. A regulator under those conditions would require to act very quickly, in fact I think it would have to shift the brushes from the heaviest point, where they would certainly be with 100 lights on a 100 light machine, to lightest point in five to ten seconds to avoid burning the dynamo very badly. Now, if regulator works in this short space of time, what is the use of limiting the test to five minutes. You may as well make it five hours, for the machines would not be generating any current after the brushes had been shifted to their lightest point.

As to the arc lamps, what is the use of asking for tenders and stating the name and style of lamp by specifying the Adams-Bagnell single carbon lamp? Does this not exclude all other makers of lamps from tendering for this part of the plant? If the Adams-Bagnell is the best lamp, and the city of London are bound to have them, why not buy them direct from the makers and thereby get a better price than they would by advertising and asking for a certain make of lamp. The makers, or agents for this lamp, can tender away up and still get the contract, as the corporation have already said we must have this make of lamp. Had the corporation asked for tenders in the usual way, they would likely have received a tender for this lamp, which would have been down among the rest; then they could have accepted this tender, and at the same time not caused the Adams-Bagnell Lamp Company to think that they were the only lamp makers in the world.

Yours truly,

T. O. CRANDEL.

TORONTO, ONT., Sept. 23rd, 1898.

DEAR SIR,—Replying to your favor of Aug. 30th, requesting my criticism of the London specifications, a copy of which you enclosed, would say:—

These specifications are quite comprehensive, and provide for a complete installation of high quality, hence a technical criticism will be more or less superfluous. Some adverse comments have, I believe, been engendered among a number of manufacturers of electrical apparatus by the action of the consulting engineer for the city of London in demanding through the specifications the furnishing of arc lamps made solely by a certain well-known company, and sold in Canada by themselves exclusively, thereby practically prohibiting or at least discouraging the makers of other lamps from tendering their respective types or makes. On this matter I have no objection to expressing my opinion as a consulting engineer.

Before dealing directly with the subject proper, it will perhaps be as well to briefly outline the position and duties to be reasonably expected of the consulting engineer in matters of this nature, in order that the apparent motives which actuated the city engineer in the present instance may be more readily be appreciated.

In the majority of proposed electrical enterprises entailing the ex-

penditure of large sums of money, the general design and technical details of the installation are placed under the direction of an expert or engineer making a specialty of such work; this engineer, after carefully ascertaining the conditions under which the plant will operate and the requirements it may be expected to fulfill, formulates the requisite specifications enumerating and describing the general and special apparatus to comprise the complete equipment, the number of each separate kind or piece of apparatus, its capacity and other necessary general details, and lastly, but most important, the minimum degree of good quality and perfection in the apparatus permissible to ensure favorable consideration of the tender. The tendency is now fortunately gaining ground among engineers to call for and insist on the purchase of only the highest and most perfectly developed apparatus, electrical or mechanical. Tenders are then received and examined by the engineer, and those providing for that quality of apparatus best adapted to meet the requirements fully are usually recommended for acceptance. I say "usually recommended," since it occasionally happens that limited finances exert a strong influence in determining the quality of the apparatus to be accepted by the purchaser. Assuming the highest quality to have been accepted on the engineer's recommendation, after reception and examination of tenders, at least two very important results will have been attained: Firstly, the purchaser of the apparatus will have benefited to an appreciable extent financially through the competitive prices received from the manufacturers of an acceptable grade of apparatus; and secondly, a very strong incentive will have been offered the manufacturers to continue developing and improving their several lines of manufacture to the utmost limits of perfection contemporaneously attainable—an incentive which cannot fail at least ultimately in producing results having an inestimable value for the human race in general.

It seems to me that the city engineer of London has faithfully endeavored to fulfill the duties of his responsible position with the above ends in view, since he has not only provided for the supplying of what he believes to be the best arc lamp on the market, but has otherwise specified qualities in the remaining portions of the plant which are certainly of a high degree. What his reasons are, however, for concluding that but one make of arc lamp is above all others the best adapted to meet the particular requirements of his clients I do not propose to discuss, and will therefore await his reply or explanation, if he be disposed to publish one. For my own part, I am of the opinion that when articles or apparatus of general manufacture, such as arc and incandescent lamps, supplies, dynamos, engines and boilers, etc., are to be purchased by tender, it will be more to the advantage of all concerned (the clients as well as the manufacturers) for the engineer to avoid specifying any particular make, even though it be of a type slightly different from the average, and instead to so present the requirements, conditions and guarantees to be fulfilled, etc., by means of a reasonably close specific description or general specifications, that the supplying of the requisite quality or essential type of apparatus can be provided for under the usual conditions.

If the engineer should feel justified in purchasing a specific make of apparatus before tenders for the remaining portions of the equipment are asked, and accordingly signifies this intention in his specifications, he renders liable the establishing of a precedent which has repeatedly proven detrimental to the best interests of clients and the electrical business in the United States. The reason for this should be apparent to the readers of your valuable paper who have had experience in these matters.

Yours very truly,

RODERICK J. PARKER.

PERSONAL.

Mr. Gardner, of the Ottawa Electric Company, has taken charge of No. 2 power house.

Mr. F. A. Cambridge has been appointed electrician for the city of Winnipeg, Man. One of the chief duties will be the inspection of electric wiring.

Mr. Alex. Hunter, for over thirty years assistant chief operator for the Great Northwestern Telegraph Company, Toronto, died last month. He was well known to the telegraph fraternity throughout the Dominion.

Mr. Charles B. Routh, of the Ottawa Electric Light Company's arc light station, has severed his connection with the company, and will in future reside in British Columbia, where he has secured a lucrative position.

The honor of being elected a member of the Executive Committee of the Street Railway Accountants' Association of America was conferred upon Mr. J. D. Fraser, secretary-treasurer of the Ottawa Electric Railway Company, at a recent convention.

Dr. John Hopkinson, the well-known English electrical engineer, was killed at Berne, Switzerland, while ascending the high Alps without a guide. Dr. Hopkinson had devoted much attention to electrical research, having given the results of his experiments in various papers read before the Royal Society and other institutions. In the year 1893 he made some improvements in the Edison dynamo, which proved to be of exceptional importance in dynamo construction. He developed to a large extent the theory of alternating dynamos, and received from the Westinghouse Company the sum of \$9,000 for his British patents on the three-wire system of distribution, which he invented simultaneously with Edison in the United States. At the time of his death, it was Dr. Hopkinson's intention to shortly sail for New York, to form a syndicate to develop other recent inventions.

The Maritime Sulphite Fibre Co., Chatham, N.B., have ordered a 500 h.p. cross compound condensing engine from the Robb Engineering Co., to replace their present 250 h.p. simple engine and to provide for contemplated enlargements of their plant. They expect their new engine to effect a large saving in fuel over the type they are now using, as well as to give much better speed regulation.

CANADIAN ELECTRICAL STUDENTS' COMPETITION.

It is the intention of the publishers of the *ELECTRICAL NEWS* to offer two or more prizes to students of electricity in Canadian schools and universities, for the best essay on a specified subject. The conditions and full particulars will be published in the *ELECTRICAL NEWS* for November. Meanwhile, it can be stated that the proposal has been favorably received by the authorities of some of the leading schools. It is hoped that the students for whose benefit chiefly the competition is being instituted, will take an active interest and thereby ensure its success.

PROF. R. B. OWENS.

PROFESSOR R. B. Owens, E.E., who has recently received the appointment to the W. C. McDonald Chair of Electrical Engineering at McGill University, Montreal, in succession to Professor Carus-Wilson, is a comparatively young man. He was chosen from among the teaching staff of the great universities of the United States, and brings with him a record for marked originality, ability and energy.

Professor Owens was born in the southern part of Maryland, a state of which his mother's great grand-



PROF. R. B. OWENS,

Professor of Electrical Engineering, McGill University Montreal.

father was the first Democratic governor. He spent three years in an old military school at Maryland, and was the youngest to graduate since its founding in 1774. After a brief connection with the old Baxter Motor Company, he resumed study at Johns Hopkins University in Baltimore, under Dr. Louis Duncan, and obtained a high standing in mathematics and physics. He was then for a time with the Excelsior Company in New York, and put in and superintended the Thomson-Houston station at Greenwich, Conn. In the year 1891 he obtained the degree of E.E. from Columbia University, having been a student under Professor Crocker.

In his organization work at Nebraska University Prof. Owens attained a high degree of success. He was first appointed Adjunct Professor of Electrical Engineering upon the opening of that department, becoming professor in 1894, and in 1895 he assumed full charge of the Department of Electrical and Steam Engineering, which position he resigned recently. While thus engaged he succeeded in building up the engineering course of that university to a high standard. He was one of the judges of electrical exhibits at the World's Fair. Prof. Owens has recently been elected to a Tyndall Fellowship by Columbia University, and is director of Bureaus of Electricity and Machinery at the Trans-Mississippi Exposition at Omaha. He is also a member of the Western Society of Engineers, the American Society of Mechanical Engineers, and the council of the Society for the Promotion of Engineering Education, and vice-president of the American Institute of Electrical Engineers.

ELECTRIC GONG BUOYS—AUDIBLE VERSUS VISUAL SIGNALS.*

By F. A. HAMILTON, E.E.

It is now some five years or more since I first made the proposition contained in this paper, viz., to make use of electricity for the purpose of facilitating navigation, more especially in providing a system of signal buoys by means of which the mariner would be enabled to reach his destination with comparative ease and safety, under conditions which normally would be both difficult and dangerous. The idea formulated was briefly as follows:

To connect by means of a submarine cable a system of buoys, fitted with powerful electric gongs, these buoys to be placed in the offing in such positions that

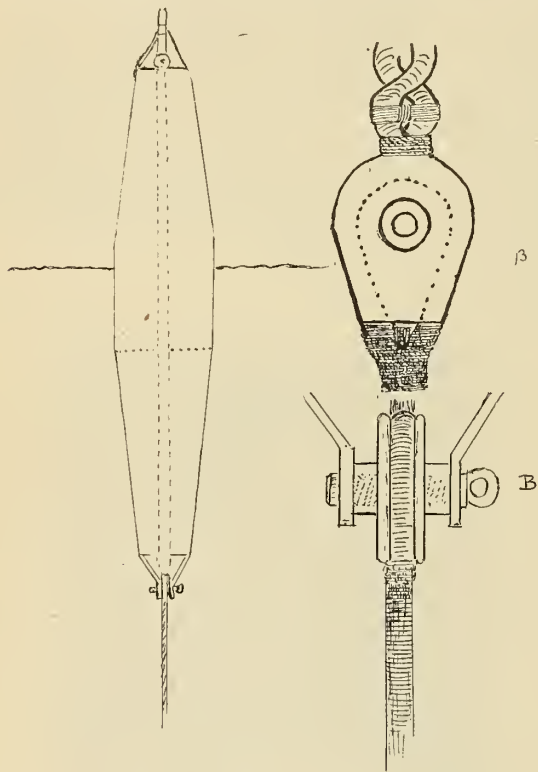


FIG. 1.

vessels could, without risk, run to leeward of them and consequently come within range of the gong signals.

It is well known that whilst even the report of a cannon can be heard but a short distance to windward, the comparatively feeble note of the automatic whistling buoy will be distinctly audible five or six miles to leeward. Bearing in mind this fact, it would seem reasonable that the vibrations which it is possible to cause by striking a bell by means of power produced and controlled by electricity could be heard some considerable distance down the wind. With this object in view I planned out the system hereinafter described.

Before proceeding to explain the details of the method proposed, I would beg to be permitted to submit a few observations with regard to the necessity of providing means for facilitating the entrance of vessels to our harbors.

Whilst it cannot be denied that the whistling buoy, commonly known as Courtney's automatic buoy, has done, and is doing good service, it must be admitted that something more is needed in the way of guides to the mariner, for these ponderous whistling buoys must necessarily be moored in shallow water, and, consequently, in the majority of cases, near the shore, so that in the endeavor to "pick up" the sound of the whistle it is necessary to run the vessel nearer to the shore and to outlying dangers than is desirable. Let us take the approaches to Halifax Harbor as a typical case.

An automatic buoy is moored on the Outer Bank, 5 miles from Sambro light, in a depth of twenty-four fathoms, and another nine miles to the north-eastward of this in 37 fathoms. To stand in to leeward of these buoys in thick weather during a southerly gale would be a hazardous proceeding, as there are many outlying dangers in the vicinity.

Taking into account the fact that the conditions of weather are such that south in the wind means fog, rain or snow, it is evident that a vessel must pass inside the buoy, that is to say, between it and the land, before the sound of the whistle will be heard. There are times, it is true, when the buoy signal will be audible in the other direction, for instance during fog unaccompanied by wind, but the point I wish to emphasize will be at once recognized when the combined conditions of a south-east gale with rain are considered. Under these circumstances we have thick weather and, for a vessel approaching the land, a lee shore. The vessel has perhaps made a rapid passage across the Atlantic. A master of ortho-dromics has navigated the latest triumph in marine architecture to within an hour's run of her destination, but, owing to thick weather, and the absence of any indication as to his whereabouts, the prudent mariner has perforce to point his ship to the wind and await more favorable conditions. It is possible that after groping about in the fog and rain, anxiously listening for the moan of the automatic buoy, and continually heaving the lead, the worn out but vigilant commander is fortunate enough to come within the range of the spasmodic toot of the buoy, but the chances are against any such lucky hit, and at the very best many hours are lost in the endeavor to establish the position of the ship, under conditions not altogether unaccompanied by danger.

Now, what would be of incalculable value to the mariner could be provided by means of a system of audible signals placed broad off in the offing at such a distance that vessels could boldly stand in to leeward, and therefore be sure of coming within range of the signals.

In order to multiply the chances of attaining the desired result, at least three buoys should be distributed across the approaches to the harbor, in a manner to be hereafter determined by those who are the best qualified to select the respective positions. The writer would here merely suggest the placing of these buoys in the positions indicated on the accompanying chart, on which it will be seen that the distribution is such that in standing across, in perfectly safe water, and parallel to the coast, a vessel could pass to leeward of the buoys, so

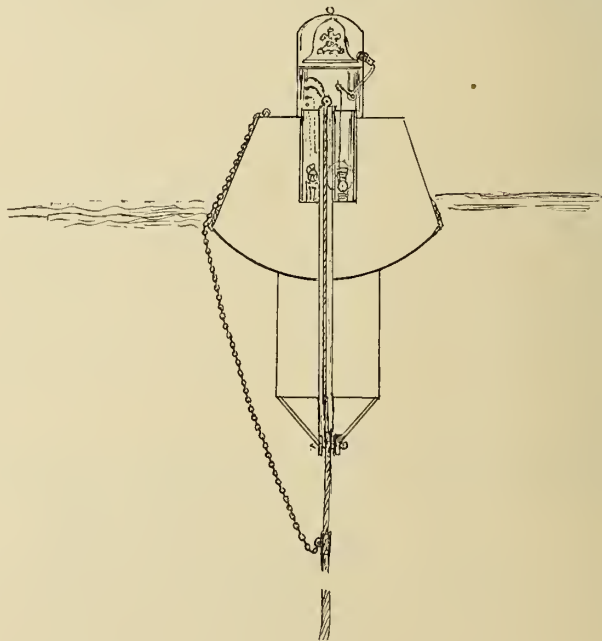


FIG. 2

that in approaching the vicinity of the harbor, a few short runs in the direction shown by the arrows would bring the ship near to and to leeward of one of the buoys.

It is, of course, well known, and recognized, with no small degree of admiration for the skill and nerve displayed, that there are certain captains for whom the weather is always clear—that is to say, it is never too thick to prevent their running in, even to the very wharf, without a glimpse of anything, save perhaps the ghostly form of Meagher's Beach light-house—but it is only fair to state that such instances are not the rule, and here it may be remarked that the chief object aimed

* Paper read at the first convention of the Maritime Electrical Association, September 27th, 1898.

at is to assist the ocean liner and other vessels that have run long distances, and not so much the coaster, with a comparatively short departure. At the same time, the fact must not be lost sight of that the additional facilities here proposed would be of inestimable value to every description of craft, including pilot vessels, which could, under the conditions proposed, patrol in safe waters.

Having indicated in a cursory manner the needs and objects of the proposed scheme, I now proceed to the details connected with the apparatus required. This part of my subject may be conveniently considered under the following heads, viz., buoys, moorings, fittings, cables and signalling appliances. A suitable form of buoy is that known as the "spar buoy," which consists of an iron cylinder terminating at each extremity in the frustum of a cone. Such a buoy is shown in Fig. 1, in which a sectional elevation is presented. The fittings consists of shackles, thimbles, bridle chain, staff and junction box. The moorings consist of the cable itself, connected to the buoy in the manner hereinafter described. Another form of buoy is shown in Fig. 2. The shape is that of a truncated cone, the base of which is the segment of a sphere with a cylinder attached, a cylinder being also recessed in the cone for the reception of a detachable cylindrical box in which the electrical and mechanical appliances are placed, and over which the bell is supported. A tube through which the cable is led is run through the middle of the buoy.

The upper part of the buoy not including the cylindrical portion is the air chamber, and the lower part provides a space for water ballast, and at the extremity of this two arms are attached, between which the cable is secured in the manner shown at B, Fig. 1, and at A and B, Fig. 3. The two parts of the cable are crossed and "seized" and worked over the thimble (b), and further "seized" below the latter. Above the thimble the two parts, twisted together and served, are led through the pipe inside the buoy, or up the side of the buoy if necessary,

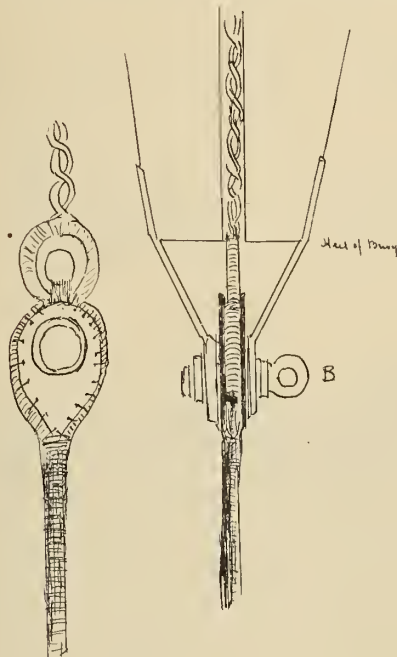


FIG. 3.

protection in this case being afforded by means of battens or other suitable appliances. A bridle is attached below the thimble and secured at a convenient place, for the purpose of facilitating the operation of disconnecting the buoy from the cable.

The main line—that is to say, the cable connecting the outer position with the station on shore—I divide into as many sections as there are buoys. Each section is connected by means of couplings, the ends of the sections being fitted with thimbles through which the coupling bolts are passed.

The coupling pieces consist of two cast iron plates, in which are three bolt holes and three slots. These plates are crowned or rounded above and below in order to provide a hollow chamber for the cable connections.

The bolts serve the double purpose of holding the two plates together and securing the cable ends to the couplings. The hollow receptacle affords protection to the joints between the main cable and the branch lines leading to the buoy. A suitable sort of coupling is shown in Fig. 4. The main cable ends 1 and 2 and the branch cable 3 are placed in their respective slots and secured in position by means of the top plate and the bolts, as shown in the diagram.

The yoke and chain are for the purpose of facilitating the operation of buoying the bight, as explained hereafter.

The following *modus operandi* is proposed: The cable having been paid out from the shore to the end of the first length, the second section is connected to it by means of the coupling. Having carefully joined the cores and secured the two ends of the cable to the coupling by means of the bolts, paying out is re-

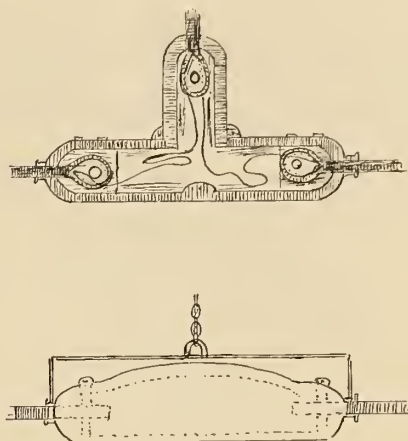


FIG. 4.

sumed, and at the same time a small anchor buoy is slipped with a convenient length of rope attached, the connection being thus readily accessible.

The yoke to which the chain carrying the buoy rope is attached is for the purpose of preventing the anchor buoy tackle from being twisted up around the coupling as it and the cable are lowered to the bottom.

The same operations are performed at the end of each section, with the exception of the end one. Here the first branch cable is connected by a perfect joint between it and the main line. The branch cable, being paid out to near the end, is secured to the buoy and the latter is slipped. The cable is then picked up at the various couplings and the branch lines connected and paid out at right angles to the main cable.

As the buoys are moored by the cable itself, it is necessary that this be provided with some protection against abrasion. This object is effected in the following manner: A rounding of chain is applied over a length of cable depending on the depth of water in which the buoy is moored and the nature of the bottom. It is to render the examination of this portion of the system comparatively easy that paying out at right angles to the main cable is recommended; besides this, it reduces the chances of wear and tear on the main line, which remains undisturbed whenever the buoy moorings are examined.

The following explanation concerning the operation of attaching a buoy to a branch cable may be of interest: Having paid out a branch line to within a few fathoms of its end, attach a slip rope. Pass a heaving line down through tube of buoy and bend on to thimble at end of cable, pull the latter up the tube, remove cover placed over the cores for protection, secure the conductors to their respective terminals in the connecting box, insert pin through eye of thimble and close the box, at the same time pass bolt through thimble of cable at heel of buoy, attach bridle chain to cable and secure it to tripod of buoy. Drop buoy and cut slip rope. In picking up the buoy and moorings the following precautions should be observed: On disconnecting the junction box, attach a "tail" of heaving line through the eye of thimble, in order to provide a means of saving the ends of core from being used as a lanyard. Secure cover over tube and close junction box. Shackle on bridle chain, heave away and cant buoy; remove bolt at heel of buoy. In order that the bolt may be easily withdrawn when the strain is taken up by the bridle, the latter may be attached to the cable at a distance of about a fathom below the thimble that carries the bolt by which the cable is secured to the buoy.

THE SIGNALLING APPARATUS.—In my original design the plan was to employ electro magnets and gongs, of large dimensions, placed on the flagstaffs. The following is an extract from a letter dated January 31st, 1893, in which I explained my proposed scheme:

"In reply to enquiries respecting my proposed system of electric bell buoys, I beg to furnish the following information: Electric bells when exposed to wet or moisture are apt to fail owing to the contacts becoming oxidised, and this is probably the chief reason why electricity has not been applied, in the manner now suggested, to marine signalling. To obviate the difficulties hitherto presented and to protect the electrical contacts from the action of damp and salt, I enclose the electro magnet and contacts in a sealed chamber or box, which whilst being impervious to water does not impair the action of the rod to which the bell hammer is attached. The sealed box containing the electro magnet is, together with the gong mounted on a cage, supported by a staff which is carried by a tripod attached to the buoy. The electric cable is passed through a tube in the buoy or up the

outside of the latter and connected to the terminals in the box. The cable is attached to the buoy in the following manner: Two parts of the cable are crossed and "seized" and worked over a thimble and further "seized" and served below the thimble. A bolt passed through the eyes of the arms of the buoy secures the thimble, which carries the cable to the buoy. The ground parts of the cable are protected from abrasion by a "rounding" of chain applied over a sufficient length to not only provide against chafe, but to ensure enough weight to moor the buoy. The type of cable recommended as most suitable for mooring the buoy consists of one made up of two closings of armor, applied in opposite directions in order to prevent any tendency to twist or kink."

Here followed a description of buoy, moorings, etc.; and an estimate of cost.

The feasibility of the system here proposed could be easily and economically proved by means of some old cable and a buoy of suitable dimensions fitted in the manner described."

The advantages claimed for this method of producing audible signals are:

1st. The certainty of the sound being emitted during calm weather when there is not sufficient swell to cause a whistling buoy to act.

2nd. Its usefulness for positions where there is no swell, such as in rivers, harbors, and channels not open to the sea.

3rd. The convenience with which the apparatus can be handled, the buoys, and consequently the moorings, being light.

4th. Its adaptability for positions in deep water where the mooring of a whistling buoy would be attended with great difficulty.

In positions where only a short length of cable would be required to connect the buoy and the shore the cost would be small, and in places where the water is smooth and the bottom favorable, light buoys and moorings could be used. There are doubtless many positions where the system would be of great value.

In reconsidering this matter I have recognised the necessity for providing a system by means of which each buoy would signal its own number, and the plan is to arrange the apparatus in such a way that in the case of a system comprising several buoys only one is in circuit at a time, so that the full power available on the line is concentrated at one point. In the case of three buoys—whilst number one buoy is striking its number, the other two are out of circuit, and when buoy two is in operation, one and three are mute, likewise when number three appeals to the elements, one and two are silent.

The simple mechanism required to accomplish this result consists of a small electric motor, which, besides performing the operation of working the lever which connects the rod leading up to the bell hammer, winds the spring of a system of clock-work by means of which the current is switched on and off at each buoy.

This portion of the apparatus, together with the bell, can be readily shipped and unshipped, so that the appliances can be easily examined and overhauled. There are possibly others who have taken up this subject since I first mooted the question. It would be interesting to know what advances they have made, and it is to be hoped that the remarks contained in this paper will give rise to such discussion as may pave the way to practical results, for there can be little doubt but that much useful work is to be done in the direction indicated.

In conclusion, I desire to state that I emphatically disclaim any intention of reflecting on the usefulness of electrically lighted buoys or of automatic whistling buoys, both of which are of the utmost value in their respective spheres. I merely claim for the system concerning which your opinion is asked a place in the advanced line of our littoral outposts.

TRADE NOTES.

The McLaughlin Carriage Co., of Oshawa, Ont., have ordered a 100 horse power Robb-Armstrong engine from the Robb Engineering Co., Amherst, N. S.

The Warwick Clothing Manufacturing Company, of Warwick, Que., are lighting throughout by electricity. The order for the necessary apparatus has been given to the Royal Electric Co.

Messrs. Boivin, Wilson & Company, of Montreal, have recently ordered from the Canadian General Electric Company a 100-light incandescent dynamo for their premises at Berthier.

The Lachine Rapids Hydraulic & Land Co. have awarded to the W. A. Johnson Electric Co., of Toronto, a contract for all the transformers (of the Wagner type) required for a year.

The Canadian Pacific Railway have purchased from the Royal Electric Company one of their 50 light 2 000 candle power arc dynamos, together with 52 arc lamps, for use in their car shops at Hochelaga.

The exhibit of John Starr, Son & Co. at the recent Halifax exhibition was very creditable and attracted much attention, being awarded a diploma and medal by the judges. The current used for the illumination was generated by their dynamo in Machinery Hall. Two telephone switchboards were to be seen, for fifty subscribers each, gotten up in handsome cases. Two styles of telephones were exhibited, stationary for the wall and portable for desk use. These instruments are made by John Starr, Son & Co., and are fitted with the new Starr transmitter, patented in Canada and elsewhere, the feature of which is the double diaphragm, enabling sound to be transmitted with increased distinctness. They are adapted for either long or short distance telephoning, and cannot easily get out of adjustment. They also show a complete line of electric supplies.

SPARKS.

The Northey Mfg. Co., of Toronto, are building a horseless carriage, to be propelled by a 6 h.p. gasoline engine.

Messrs. H. Vick & Sons, of Orillia, recently ordered from the Canadian General Electric Company a 50 light incandescent dynamo.

The town of Newmarket, Ont., has granted a franchise for an electric railway to the Metropolitan Railway Company.

A young man named Aikens was killed last month by the explosion of a hoiler in the brickyard of F. W. Entricken, near Tavistock, Ont.

The Frederickton Electric Company have under consideration the erection of a new power house, rendered necessary by insufficient accommodation.

The Midland Elevator Co., of Midland, Ont., are having placed in their elevator a fifty light T-H dynamo, from the works of the Royal Electric Company.

The Deseronto Iron Company, of Deseronto, Ont., have closed a contract with the Canadian General Electric Company for a 200 light dynamo, with marble switchboard for same.

The Packard Electric Company, Limited, of St. Catharines, Ont., have issued a neat booklet, giving the code word for various terms and phrases used in the electrical supply trade. This should prove very useful to central stations.

Messrs. Tromanhauser Bros., of G. derich, have placed an order with the Canadian General Electric Company for a 200 light incandescent dynamo which they propose to install to light their elevator buildings.

The Bell Telephone Company expect to have their new building in Quebec completed early in January. The company are also doing considerable work in the way of placing large cables underground.

The British Columbia Electric Railway Company, in order to meet the increased traffic over their road, recently placed an order with the Canadian General Electric Company for additional car equipments of the well-known C.G.E. 1,000 type.

Mr. Percy Domville has been instructed by the Hamilton City Council to prepare an estimate of the cost of an electric light plant, buildings, etc., for 500 arc and 3,000 incandescent lights, and for 700 arc and 5,000 incandescent lights.

The Y. M. C. A. of Montreal have established a course for the study of electricity, under the direction of Mr. Louis A. Herdt, E.E., of McGill College. The department will be equipped with the latest apparatus for experimental work.

It is rumored that, as a result of the franchise granted by the city of Ottawa to the Metropolitan Electric Company, the Deschenes Electric Company will again win its effort to secure a franchise for electric light and power from the city.

The Canadian Pacific Railway smelter, at Trail, B. C., recently placed an order with the Canadian General Electric Co. for a 50 light 2,000 c.p. Brush arc dynamo, together with the necessary lamps for same. These are to be used at their smelter works at Trail.

Messrs. John Ballantine & Son, of Preston, have given a contract to the Canadian General Electric Company for a lighting plant, including a 100 light dynamo with instruments. The order includes the wiring up of their premises for use of incandescent electric lighting.

The storage sheds of the Montreal Street Railway Company at Hochelaga were destroyed by fire on September 16th. Sixty cars were burned, on which there was an insurance of \$2,500 each. Seven sweepers, just half of the company's equipment, were also destroyed.

The city council of Hamilton, Ont., has agreed to extend the franchise of the Hamilton Street Railway Company for fifteen years from 1913. It is said that as a result of this extension, the company will undertake considerable improvements to the system at an early date.

The scheme to utilize the water power of Whiteman's Creek for the supply of electric light and power to the city of Brantford, Ont., and vicinity, has been revived. There is a head of 18 feet, and the dam and race are in good condition. The promoters claim that 75 h.p. could be obtained the year round.

The village council of Acton, Ont., have appointed a committee to visit Aurora, Newmarket, and other places where municipal electric plants are in operation, and secure all possible information on the subject. The report, which will shortly be presented, will likely recommend the installation of a plant by the village.

The earnings of the Toronto Street Railway Company for the fortnight commencing Monday, August 29th, and ending Saturday, September 10th, 1898, were the largest on record. During the two weeks the company carried 1,879,298 passengers, making a total increase in receipts over the same period last year of \$15,167.11.

The Hamilton Blast Furnace Company, of Hamilton, Ont., have given a contract to the Canadian General Electric Company for the installation of a 150 light incandescent dynamo, with switchboard and the necessary instruments, and are also having the factory wired up for the use of incandescent lights and long burning direct current arc lamps.

The new contract between the city of Brantford and the Brantford Electric and Operating Company came into force recently. Instead of arc lights of 68,000 candle power, there are now over 20,000 candle power, while the price has been reduced from \$8.95 to \$53 per lamp. Incandescent lights have been reduced from \$10 for 16 c.p. lamps to \$9.60 for 32 c.p.

The T. Eaton Company, Limited, of Toronto, have given an order to the Canadian General Electric Company for the installation of a 130 kilowatt direct connected generator, with marble switchboard, containing the necessary instruments for the generator. When this generator is installed the T. Eaton Company will have three 130 kilowatt generators and two 50 kilowatt generators of the Canadian General Electric Company's well-known type.

The annual meeting of the Great Northwestern Telegraph Company was held in Toronto on September 28th, at which the following directors were re-elected: H. P. Dwight, president and general manager; Adam Brown, of Hamilton, vice-president; H. N. Baird, James Hedley, A. S. Irving, C. A. Matthews, of Toronto, Richard Fuller, of Hamilton, Hon. William McDougall, C.B., of Ottawa, and Charles A. Tinker of New York, directors; George D. Perry was reappointed secretary and auditor, and Arthur Cox treasurer. The statement of the year's business showed a considerable improvement over the previous year.

A public demonstration of the Bonner rail wagon, as described by Mr. W. T. Bonner in a paper read at the last convention of the Canadian Electrical Association, was made at Toledo, Ohio, on September 9th, and was regarded with much interest by the public. Col. Bonner showed how the wagons were unloaded from the trucks by means of incline planes, and how they were again loaded by reversing the former operation. Packages will be carried at the rate of 10 cents per hundred pounds, with a regular rate for carloads. The company will have regular schedule time for through trains to outside towns, and will do a general freight business in traffic which is too small for the railroads to handle advantageously.

A meeting of the shareholders of the Royal Electric Company has been called for October 18th, for the purpose of authorizing an issue of preferred stock, and the acquisition of shares in the Chambly Mfg. Co. for an additional amount of \$100,000. In 1894 and 1895 the company sold in England \$750,000 of its bonds, bearing 4½ per cent. interest. \$37,500 of said bonds being redeemable and re-deemed every year. By pledging preference stock the company is now in a position to command capital in England at a materially low rate of interest. In view of the continued and constant growth of the company's business, demanding large extensions and additions, the board of directors deem it advisable to raise, for the time being, additional capital in England by means of a loan on the pledge of preference paid-up stock.

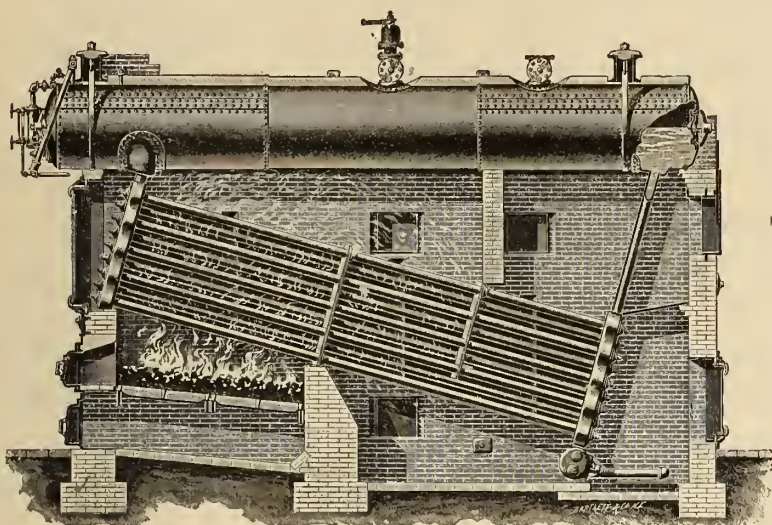
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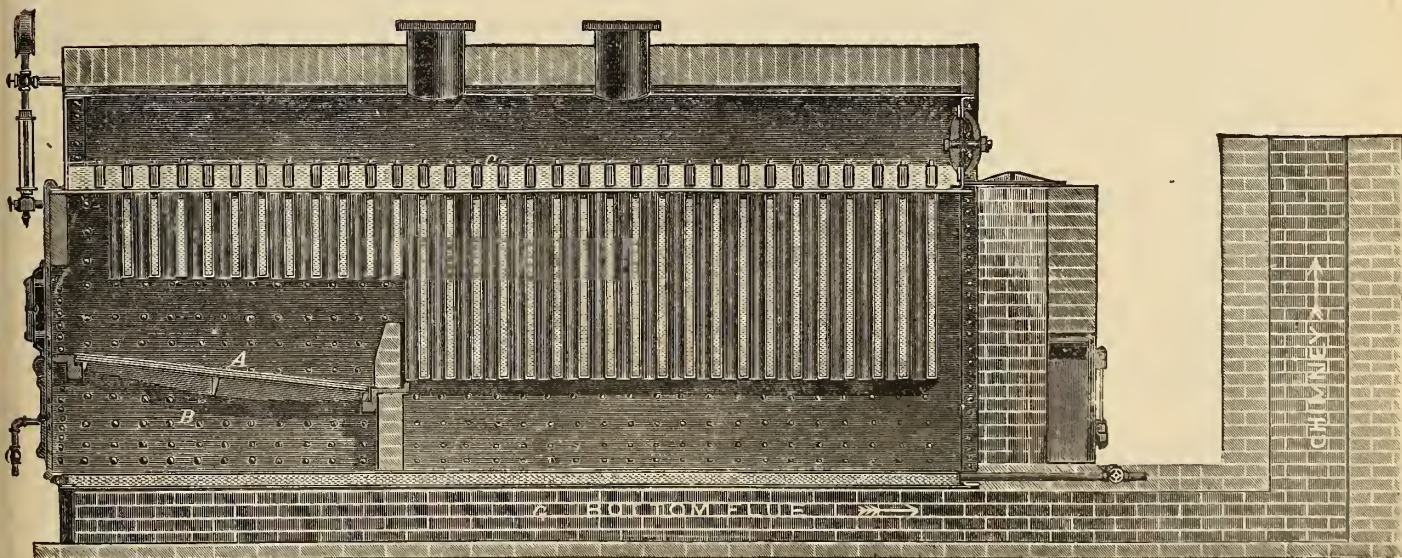
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SPARKS.

The Chambers Electric Light Company, Truro, N. S., have added to their plant a 1,200 light dynamo.

Some of the aldermen of Hull, Que., are discussing the question of municipal ownership of electric light.

A charter for an electric or steam railway from Sault Ste. Marie, Ont., to Michopicotene, has been applied for.

The Stevens Manufacturing Company, of London, Ont., have discontinued the electrical department of their business.

The Vernon & Nelson Telephone Company has completed its telephone line from Greenwood City, B.C., to Spokane, Wash.

The C. O'Dell Electric Company, of Annapolis, N. S., have just installed a Leonard-Ball automatic engine in their lighting station.

The council of the town of Mitchell, Ont., will submit a by-law to the ratepayers to borrow the sum of \$5,000 to improve the electric light plant.

During Exhibition week the Ottawa Street Railway Company carried 267,000 passengers. This was an increase of 31,000 over the record of the previous year.

The C. P. R. telegraph operators at Winnipeg, Man., have established an institute, containing a reading room and library. Means will be afforded for the study of electricity.

The Bell Telephone Company have reduced their prices in Chatham, Ont., from \$25 to \$20 for telephones in dwellings. The rental for stores and business places remains the same.

Mr. Thos. Hilliard, of the Winnipeg branch of the Canadian General Electric Company, has just installed two generators for the Brandon Electric Light Company, of Brandon, Man.

The Hamilton Electric Light and Power Company have lately placed in their lighting station one 2,000 light Royal alternator and one 100 h.p. 250 volt direct current Royal power generator.

The town of Galt, Ont., by a vote of the ratepayers, has decided to operate the gas and electric light plants. Unless the existing works are taken over, entirely new plants will be installed.

The town of Barrie, Ont., having authorized the purchase of an electric light plant, negotiations are now pending looking to the taking over of the Barrie Electric Light Company's plant at a valuation.

The Toronto Street Railway Company is building a new shed for the housing of street cars. It will be 324 feet long, 60 feet wide and 20 feet high, closed in with corrugated iron siding and having gravel roof.

The town council of Ingersoll, Ont., has appointed a committee, consisting of Mayor Mills and Aldermen Clarke, Macauley, Horsman and Fleet, to negotiate for the purchase of the Ingersoll Electric Light Company's plant.

A scheme is said to be on foot for the construction of an electric railway from Waverley, N. S., to Dartmouth, thence to Musquodoboit Harbor and Little Musquodoboit. The promoters will shortly discuss the matter with the Dartmouth Board of Trade.

The Citizens' Electric Light Co., of Smiths' Falls, Ont., are increasing their electric lighting plant, and have purchased from the Royal Electric Co. one of their 1,500 light "Royal" incandescent dynamos, with station apparatus complete. This is to be installed at once.

Tenders were received as follows by the city council of St. John, N.B., for fitting up the ferry steamer "Western Extension" with an electric light plant: James Hunter, \$337; F. W. & J. W. Myers, \$345; Geo. F. Calkins, \$950. The tender of James Hunter will likely be accepted.

The Toronto Street Railway Company is said to be considering the advisability of extending the Toronto and Scarboro railway from the present terminus, at the Hunt Club, to the west side of the Highland Creek hill, a distance of seven miles. Mr. James McDougall, C.E., has made a survey of the proposed route.

The Canadian Electric & Water Power Co., of Perth, Ont., are installing a 5 h.p. two-phase S.K.C. motor. This is the third installation within a short time, and shows what can be done with the polyphase system for developing a power trade for electric light companies and assisting to make the much desired day load.

A Technical Commission, appointed by the city of Paris, France, has lately concluded tests of 110 mechanical stokers, and awarded a prize of 5,000 francs to the one giving the best results. The competitive stokers represented 76 from France, 19 from England, four from Germany, three from America, three from Austria-Hungary, two from Italy, one from Belgium and one from Poland.

The Western Canada Telephone Company, Limited, composed of British stockholders, has been incorporated, with a capital of £60,000, to acquire and construct telephone lines and deal in machinery relative thereto in British Columbia. Among the promoters are J. H. Wade, Bradford, and R. I. Cratchley, Dewsbury, England.

No definite information is to hand regarding the intentions of Messrs. Haines, of New York, the purchasers of the Niagara Central Railway. It is rumored, however, that they are considering the advisability of converting the road into an electric system. The plans may also include the extension of the road to Port Dalhousie.

The tender of the W. A. Johnston Electric Company, of Toronto, has been accepted by the town of Beeton, Ont., for the installation of an electric light plant, at the price of \$1,900. Two other tenders were received, at \$2,200 and \$3,151. Steps will be

taken at once to erect a power house and purchase the necessary engine and boiler.

The Metropolitan Railway Company propose to extend their railway north to Lake Simcoe, west to Schomberg, and in a north-easterly direction to Jackson's Point, Roach's Point and Beaverton. When the extensions are completed, there will be a special service for light freight, as well as a regular passenger service. The new power house now being constructed at Bond Lake will replace the present one near Tannery Hollow.

Everyone has heard something of the wonderful fruit district of the Niagara Peninsula, and has promised that some day they would visit the great garden spot of Canada. The management of the Hamilton, Grimsby and Beamsville electric railway, which runs through the district, has just issued a handsomely illustrated booklet, describing the whole peninsula, and telling a good deal of the wonders of the fruit harvest there. It will be sent free to anyone writing for it.

Concrete has been adopted in place of stone for the masonry in the subways of the Chicago, Milwaukee & St. Paul railway crossing under the Chicago elevated railway tracks. The side walls, foundations and arches are being constructed of it, and an unusual arrangement has been adopted whereby a 5 horse power Ransome concrete mixer is belt-driven by a Fairbanks gasoline engine. It is stated that 3,000 cubic feet of concrete is mixed and delivered in ten hours by a force of six men.

The shareholders of the Montmorency Electric Power Company, of Quebec, have ratified the action of their directors in selling the property of the company to the Quebec, Montmorency and Charlevoix Railway Company. The shareholders of the Montmorency company not only receive for each \$100 share of their stock in that company a share of an equal amount in the Quebec, Montmorency and Charlevoix railway, but also a twenty year debenture of \$100 at 5 per cent.

Reverting to the recent fire at the London Electric Company's works at London, Ont., we learn that the second night after the fire the lamps were again lighted. It is said that two hours after the fire was discovered an order was placed for new belting, and twelve hours later it was being fitted to the machines. The generators which were destroyed were also replaced at the earliest possible moment. The citizens are to be congratulated upon the efficient service rendered by the company, under the management of Mr. C. B. Hunt.

The directors of the Hamilton, Grimsby and Beamsville Railway Company were recently waited on by a deputation of farmers in the township of Louth, who requested that the railway be extended from Beamsville to St. Catharines. Mr. R. S. Martin, on behalf of the company, stated that to do this it would be necessary to obtain a new charter. The building of the road, he said, would depend upon the cost of construction, a report on which would be made by Mr. James Patterson, the company's engineer.

The C.P.R. Company's new transcontinental telegraph wire, a description of which appeared in the ELECTRICAL NEWS for June last, was completed within the past month, and at 5 o'clock on September 20th the first message was flashed from Montreal to Vancouver. The line passes via Vaudeuil and the short line to Ottawa, and thence by the main line to the coast. The actual distance covered is about 2,900 miles, constituting probably the longest direct line in circuit for daily work in the world. To pass across this immense distance signals occupy only one-fifth of a second.

Signs of the Times

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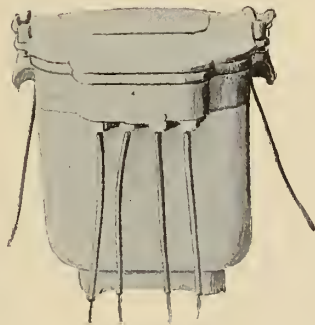
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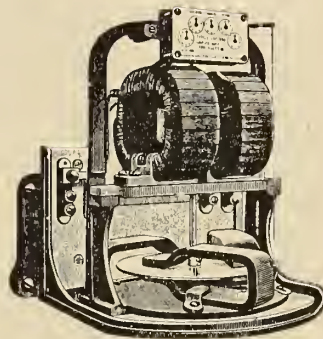
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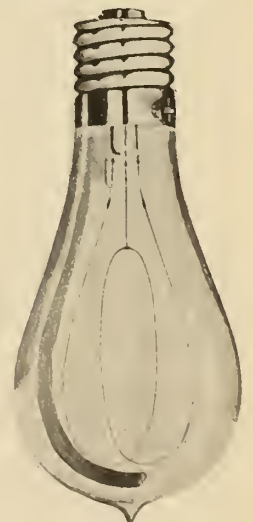
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CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

NOTE.—Secretaries of Associations are requested to forward matter for publication in this Department not later than the 6th of each month.

MONTREAL NO. 1.

At a regular meeting of Montreal No. 1, held in their hall, No. 1863 Notre Dame street, recently, it was unanimously carried that the meeting of September 26th be an open meeting, to which the public in general, and all those interested in the C.A.S.E., be cordially vited. The subject under discussion that evening was a paper on the "Precipitation System of Sewage Disposal," as in operation at Hamilton, Ont., by P. McNaughton.

BRANTFORD NO. 4.

The above association has elected the following officers: President, Arthur Ames; Vice-President, Thos. Pilgrim; Secretary, O. S. Merrill, Brantford Carriage Co.; Treasurer, A. C. Walker; Conductor, J. Nichols; Door-Keeper, A. McKinnon. The Secretary writes that they are in a prosperous condition, having made all arrangements for the coming winter.

Why does it cost less to run a condensing engine than a non-condensing one with the same machinery running in the factory? Simply because the former develops less total power than the latter. The area of the card will be the same, but the average height above the vacuum line will be less in the former case, and this is what determines the total power developed at a given speed.

CEMENT FOR LEATHER BELTING.—The importance of suitable cement for making joints in leather driving belts has led the Society of Chemical Industry to endorse the following formula: First, equal parts of good hide glue and American isinglass, softened in water for 10 hours, then boiled with pure tannin until the whole mass is sticky, the surface of the joints to be roughened and the cement applied hot; second, one kilogramme of finely shredded gutta percha digested over a water bath with 10 kilogrammes of benzol until quite dissolved, when two kilogrammes of linseed oil varnish are stirred in; third, one and a half kilogrammes of finely shredded india rubber are completely dissolved in 10 kilogrammes of carbon bisulphide by heating, and while hot one kilogramme of shellac and one of turpentine are added, and the solution heated until the two latter ingredients are also dissolved; fourth, one kilogramme of best glue is dissolved at a moderate heat in one and a half kilogrammes of water, and thickened to the consistency of syrup. One hundred grammes of thick turpentine and five grains of carbolic acid are carefully stirred in while hot; the mixture to be poured into flat tin pans and allowed to cool, then cut into pieces and dried in the air. The cement is made liquid with a little vinegar and applied to the point with a brush; this being done, the two ends of the joint are properly placed together and thoroughly pressed between two iron plates heated to a temperature of about 86 deg. Fah.

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THAT a first-class catalogue is appreciated by the trade is apparently recognized by the Canadian General Electric Company, who have, in their recent production relating to electrical supplies, surpassed all previous attempts in this direction. This supply catalogue contains some 350 pages, seven by ten inches in size, and enclosed in a beautiful cover. Upon opening the book we find in the front nicely printed half-tone illustrations of the company's works at Peterboro', the head office and warehouse in Toronto, and the branch offices at Montreal, Vancouver, Winnipeg and Halifax. Then comes the catalogue proper of the various lines of electrical goods, divided into the following departments: Switches, sockets and receptacles, cut-outs, miscellaneous incandescent supplies, incandescent lamps, shades, fixtures, construction material, tools, arc light supplies, instruments, rheostats and circuit breakers, lightning arresters, transformers, marine appliances, fan motors, electric cooking and heating appliances, bell supplies and house goods. We find also valuable wiring tables and data, the telegraph code, an index to code words, index to materials, and the rules of the National Board of Fire Underwriters for the installation of wiring and apparatus for electric light, heat and power. Altogether, it is a book of almost inestimable value to central station managers and purchasers of electrical supplies, and a credit to the compilers, the Canadian General Electric Company.

MOONLIGHT SCHEDULE FOR NOVEMBER.

Day of Month.	Light.	Extinguish.	No. of Hours.
	H.M.	H.M.	H.M.
1....	P.M. 5.10	P.M. 8.50	3.40
2....	" 5.10	" 8.50	3.40
3....	" 5.10	" 9.50	4.40
4....	" 5.10	" 10.50	5.40
5....	" 5.10	" 11.50	6.40
6....	" 5.10	A.M. 12.50	7.40
7....	" 5.10	" 2.00	8.50
8....	" 5.10	" 3.00	9.50
9....	" 5.10	" 4.00	10.50
10....	" 5.10	" 5.00	11.50
11....	" 5.10	" 6.00	12.50
12....	" 5.10	" 6.00	12.50
13....	" 5.10	" 6.00	12.50
14....	" 5.10	" 6.00	12.50
15....	" 5.10	" 6.00	12.50
16....	" 5.10	" 6.00	12.50
17....	" 5.10	" 6.00	12.50
18....	" 5.10	" 6.00	12.50
19....	" 5.10	" 6.00	12.50
20....	" 7.00	" 6.00	11.00
21....	" 10.00	" 6.00	8.00
22....	.....	" 6.00	5.50
23....	A.M. 12.10	.....	
24....	" 2.00	" 6.00	4.00
25....	" 3.00	" 6.00	3.00
26....	" 3.00	" 6.00	3.00
27....	No Light.	No Light.	
28....	No Light.	No Light.	
29....	No Light.	No Light.	
30....	P.M. 5.00	P.M. 9.00	4.00

Total..... 227.40

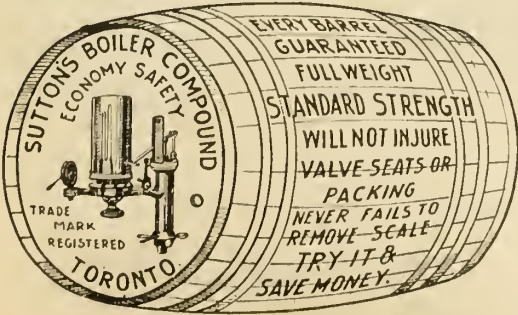
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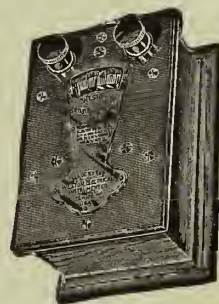
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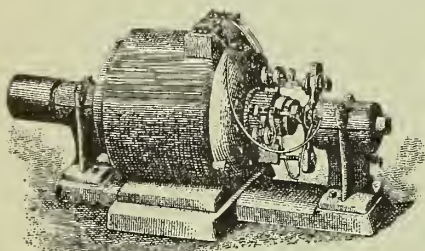
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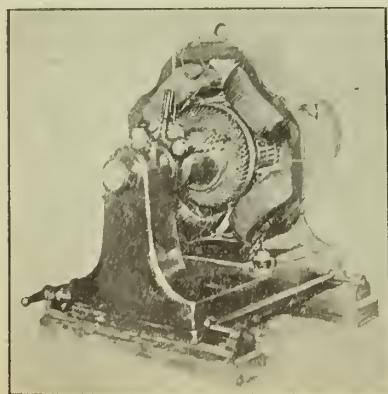
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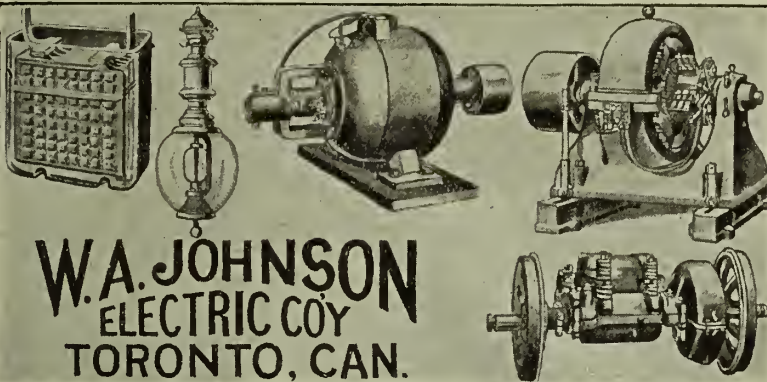
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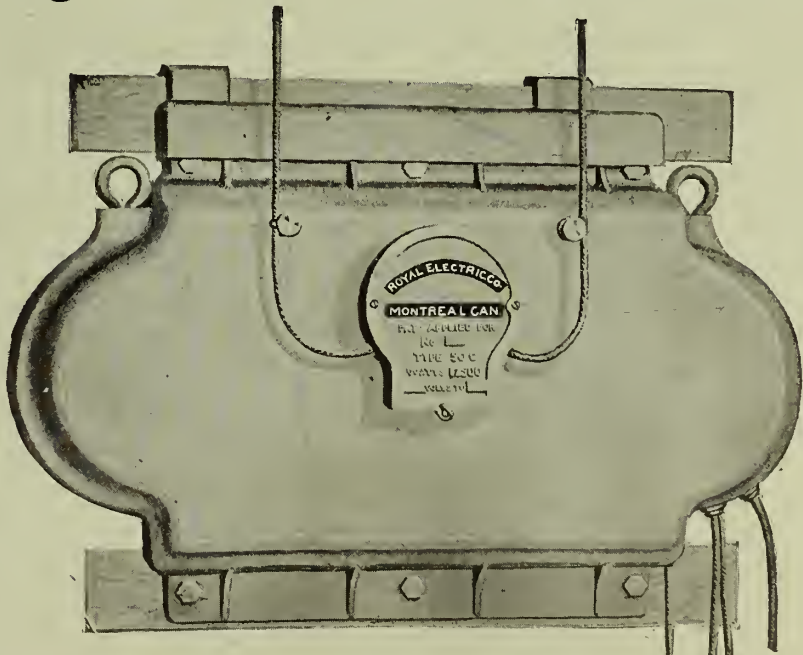
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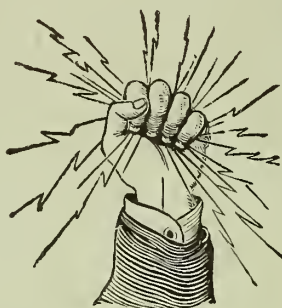
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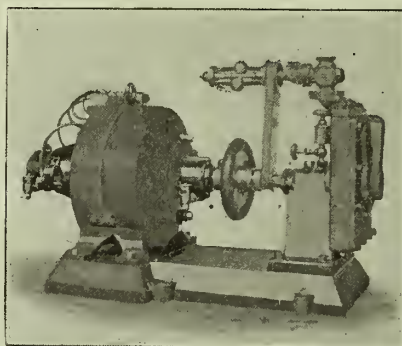
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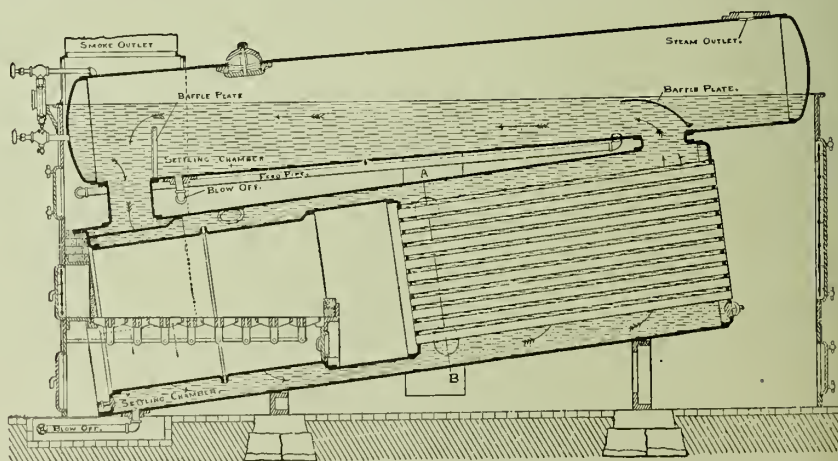
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**THE CANADIAN BRYANT
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No. 301 ST. JAMES ST.,
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McCORMICK TURBINES

State your
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Catalogue



Estimates
Furnished for
Complete
Power Plants,
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Guaranteed

Represents a pair of 30-inch McCormick Turbines, with Governor and Fly-Wheel for regulating speed. The Turbine Shaft is direct-connected to a 750 k.w. Generator.

Four Outfits like this, developing 5,000 h.p., and one pair of 51 inch of 1,350 h.p., furnished the Sacramento Electric, Gas & Railway Co., Folsom, Cal. Power is transmitted 23 miles.

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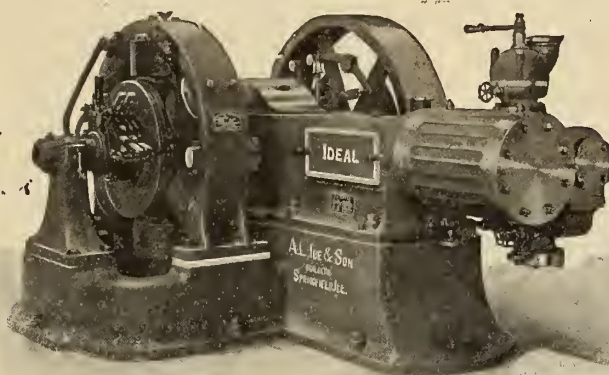
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Stave Machinery,
Fire and Burglar-Proof
Safes and Vault Doors.

THE "IDEAL" HIGH SPEED ENGINE, DIRECT-CONNECTED.

SPECIAL ATTENTION called to the "WHEELLOCK" IMPROVED STEAM ENGINE, also the "IDEAL" HIGH SPEED ENGINE, cut of which appears above, as being Unequalled for Simplicity, Efficiency and Economy in Working, and Especially Adapted for Electric Lighting, Street Railways, Etc.

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MANUFACTURERS OF THE

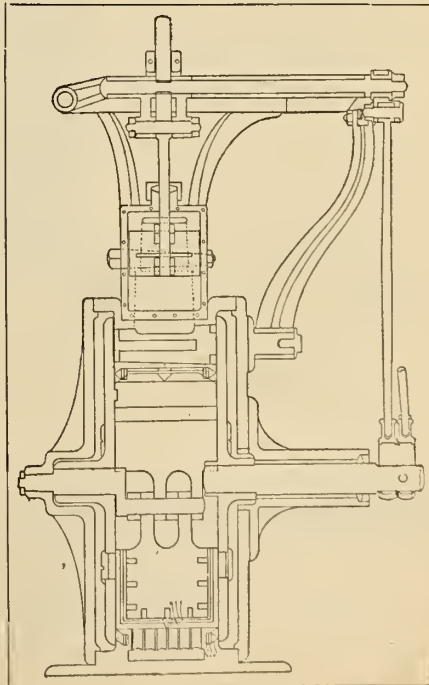
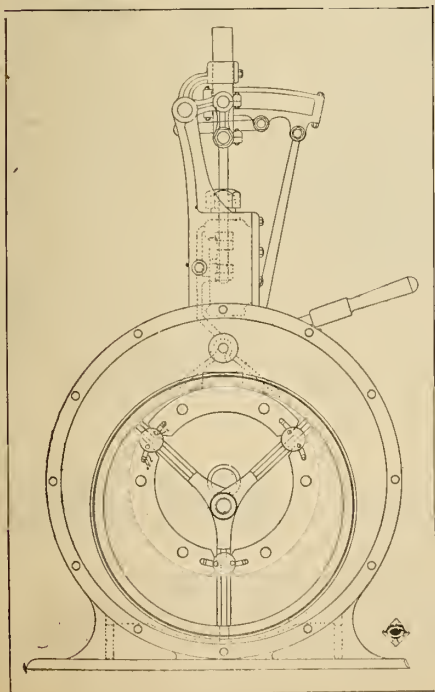
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More Heat from Soft Coal, Slack or Screenings than from the Best Select Lump or Steam Coal burned on Stationary Bars. 10 to 25% Saving in Fuel Bills easily effected by using cheaper fuel on JUBILEE BARS.

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THE JUBILEE GRATE BAR CO. of Toronto, Limited,
Office and Factory: Esplanade, Foot of West Market St., TORONTO, ONTARIO
and **THE GOLDIE & McCULLOCH CO., Limited, Galt, Ontario**

[COPY.]
THE JUBILEE GRATE BAR CO., Toronto.

TORONTO, Jan'y 8th, 1898.

DEAR SIR,—Answering your enquiry as to our opinion of the Jubilee Grates, would say that we have had them in use for over a month, and have found them very satisfactory. We are saving over \$2.00 in our coal bill per day for 10 hours' work. With the old grates we could not get steam without using Screened Lump Soft Coal; now we use Soft Coal Screenings, and we are developing about 24 h.p. more than we could with the old grates. You have already taken a memorandum of the tests that were made of the old and the new grates; we have checked over the figures to-day and find them quite correct.

Yours truly,
(Sgd.) THE TORONTO RADIATOR MFG CO., Limited.
Jno. M. Taylor, Sec'y-Mgr.

SUTTON'S BOILER COMPOUND

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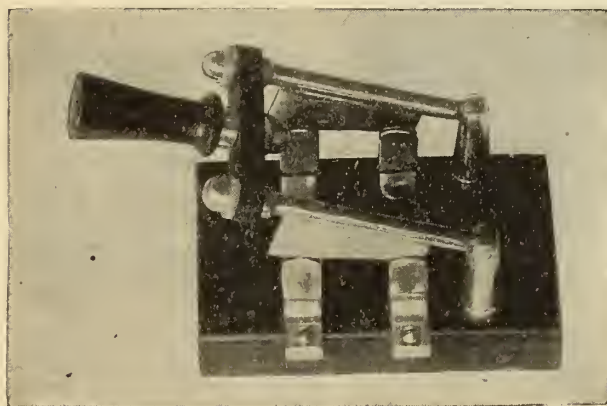
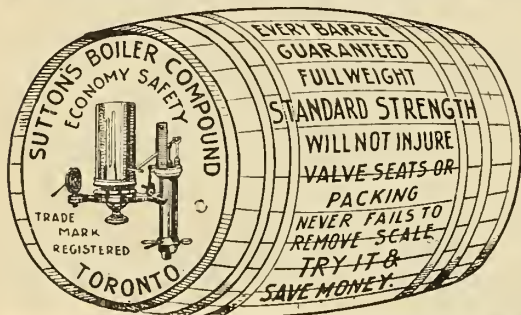
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SAVES FUEL, TIME AND REPAIRS

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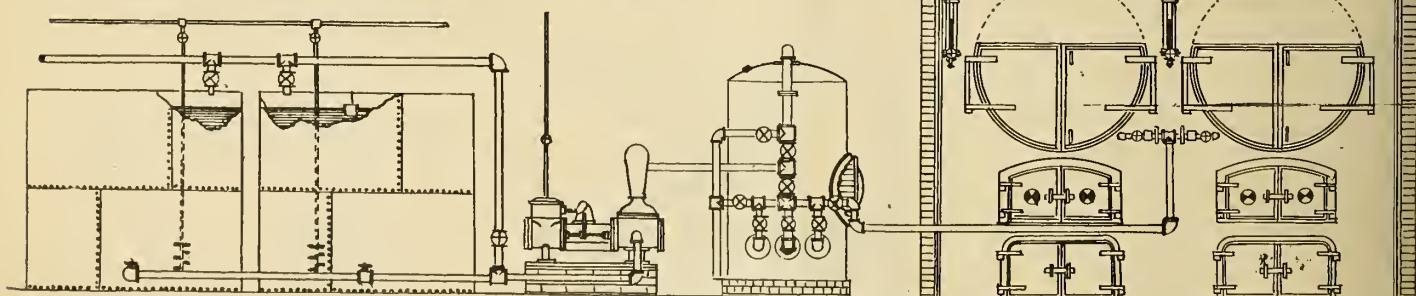
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SAVE FUEL

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CANADIAN
ELECTRICAL NEWS
AND
STEAM ENGINEERING JOURNAL.

VOL. VIII.

NOVEMBER, 1898

No. 11.

NOVEL MOUNTAIN RAILWAY.

In the July issue of the World Wide Magazine, published in New York, we find an article on "Mountain Railways," by Mr. Salvatore Pannizzi, who describes and illustrates some of the novel railroads built over precipices and mountains in different parts of the world. One of these, in the Australian Alps, is operated by a balloon, as shown by the accompanying illustration. Concerning this peculiar railway the writer says :

The last mountain railway we have to deal with is, perhaps, the most extraordinary of all, the motive power being not steam, nor electricity, but a balloon ! Stranger still, the official stamp of approval has just been put upon this marvellous railroad, which goes to and from the summit of Hochstauffen Mountain at Bad-Reichenhall, the well-known watering place in the Austrian Alps. The Aerostatic Railway—to give it its correct designation—owes its inception to the well-known inventor, Herr Volderauer, who had long ago convinced the experts that his scheme was perfectly feasible and safe. A single rail guides the cars, and keeps the balloon with its load captive, the cars gripping the rail at the sides and underneath the flange. At about every 15 feet the line is firmly anchored. In descending the mountain, of course, gravity is the

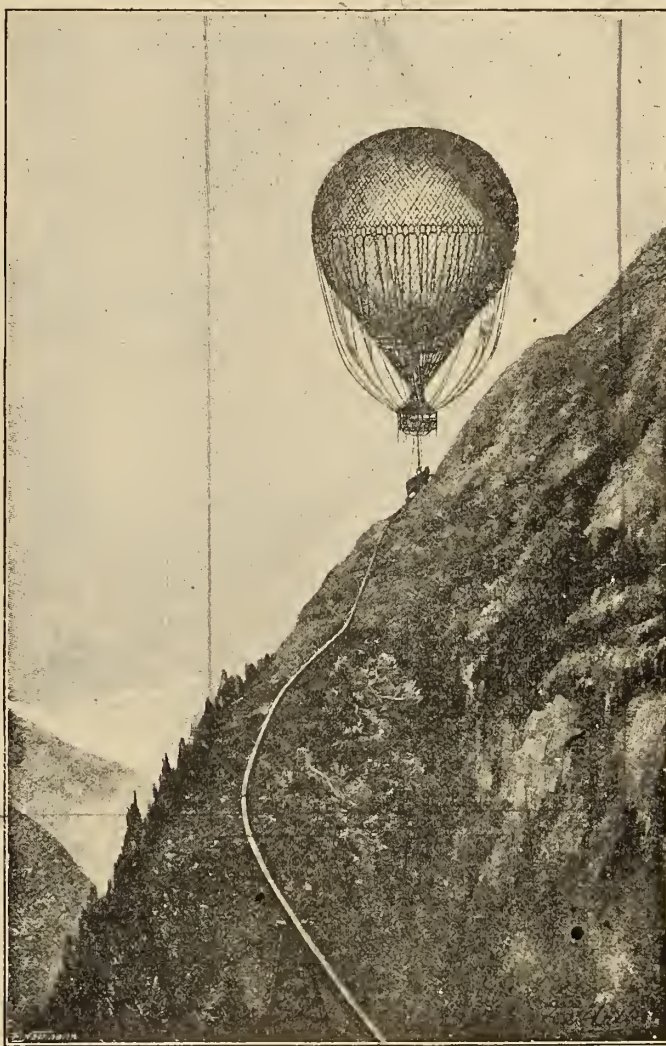
propelling force, water-ballast being taken aboard at the upper end to counterbalance the buoyancy of the balloon. The cock on the water-tank of the car can be opened by the operator at any time. The tank carries about 800 lbs. of water, and tank and car together weigh about 600 lbs. The balloon is 67 feet in diameter, and exerts a lifting capacity of something over 11,000 lbs. Weights, also, can be taken aboard and discharged at the various stations along the line. At the foot of the track are the gas-tank and generator. The summit of the Hochstauffen

offers a sublimely beautiful view ; but before the advent of the Aerostatic railway the climb was both long and tedious. It was only attempted by experienced mountaineers. The illustration shows the balloon dragging up its car on the single rail.

THE GAS ENGINE.

In a paper read before the North British Association of Gas Managers, Mr. W. C. Peebles

thus spoke of the gas engine : " There can be no doubt that a great deal has yet to be done to improve the action of the gas engine. The main direction in which a change must be looked for is, I think, in the cycle. But this would seem almost impossible without introducing complicated mechanism. At present—at least with the smaller sizes—the successful competition of the gas engine with the steam engine is chiefly due to the convenience and economy with which the gas engine can be operated, especially for intermittent work. With engines above 40 or 50 horse power, using producer gas, the cost of working is greatly in favor of the gas engine, as has been proved time after time. We shall find, therefore, that large gas engines will not stop at 400 or 500 horse power, but increase gradually year by year until they compete



NOVEL MOUNTAIN RAILWAY.

in power with the largest steam engines made. What the gas engine has done for the benefit of small masters it is impossible to estimate. Many hundreds of these employers were driven out of existence by the introduction of the steam engine. But they are gradually springing up again, and, with the aid of the gas engine, they are able to secure a respectable share of the trade. That the gas engine will rank in the near future as one of the chief sources of power there can be no doubt."

REPORT ON LIGHTING PLANT FOR CITY OF HAMILTON.

A REPORT has been presented to the city council of Hamilton, Ont., by Mr. Percy Domville, on the cost of installing and operating a municipal electric lighting plant. For the purpose of comparison the report is in two divisions: First, description and cost of installing and operating an arc plant for lighting of city streets, with an addition to arc plant for civic incandescent lighting; and second, description and cost of installing and operating an electric incandescent lighting and power plant, for both commercial and civic purposes, in connection with an arc lighting plant.

{ARC LIGHTING PLANT.

In describing the proposed arc lighting plant for 500 lights, Mr. Domville states that one 500 horse power tandem compound condensing engine and condensor, capable of supplying power for 550 arc lamps of 2,000 c.p. each, or 650 arc lamps of 1,200 c.p. each, will be required. The necessary boiler capacity is given as 636 h.p., in three units. Two boilers would be sufficient, but he deems it advisable to have one in reserve. Five 125 light self-regulating series arc dynamos, capable of sustaining a steady current of 9.6 amperes, or 2,000 c.p. per lamp, are provided for, leaving one dynamo to spare. With the increase of the number of lights to 700, another dynamo would be required, but in view of the improvements being made, he recommends the postponement of the purchase until such machine is required. Five hundred double carbon arc lamps of the clutch type, each of 2,000 c.p., with globes, cut-outs, etc., fitted for $\frac{5}{8}$ carbons, are specified. The lamps are to be divided into nine circuits of 55 lamps each. As to maintenance, Mr. Domville states that by locating the plant adjoining the sewage interception works, the present engineer and fireman could be used, and, with an assistant, would be sufficient to operate both steam plants. With the latest type of compound condensing engines, fitted with economizers, etc., a great saving of fuel could undoubtedly be effected. The amount of coal required is variously estimated from 5 pounds per horse power per hour for a simple non-condensing engine to 1,765 pounds per horse power per hour for a triple compound condensing engine. Taking 4 pounds per horse power per hour as a fair estimate, assuming the efficiency of engines and generators to be 90 per cent., and efficiency of line to average 93 per cent., one pound of coal will, the report states, produce 140.49 watt hours. The estimate provides for four generators running ten hours per day, each 9.6 amperes, 6,250 volts, or a total output of 2,400,000 watt hours per day. Estimating 140.49 watt hours per pound of coal, the amount consumed daily would be 17,083 pounds, or an annual consumption of about 3116 tons.

An addition to the above plant for the purpose of supplying 1000 lights for civic incandescent lighting would, it is stated, necessitate increasing the size of the engine from 500 to 600 horse power, and installing a 50 k.w. alternating dynamo of 1000 light capacity, with exciter and small switchboard. Additional wires, transformers and poles would also be required, and the cost of operation would be slightly higher. The present consumption is 125,000 watt hours. Assuming that one pound of coal will produce 140.49 watt hours, an additional consumption of 888 pounds per day, or 162 tons per annum, is figured upon.

Estimates of the cost of installation and operation of a plant as above are given as follows:

APPROXIMATE COST OF INSTALLING A CIVIC ELECTRIC ARC PLANT OF 500 LIGHTS.

STEAM PLANT—

One (1) 500 horse power tandem compound condensing engine and condensor, erected and connected ready for operation.....	\$5,000 00
Three 212 horse power boilers, erected and connected ready for operation.....	11,550 00
One boiler feed pump.....	300 00
Contingencies.....	2,000 00
	<u>\$18,850 00</u>

ELECTRIC PLANT—

Five (5) self regulating series arc lighting dynamos, 125 2,000 c.p. lights capacity, at \$2,750.....	\$13,750 00
One (1) ten circuit switchboard, complete.....	300 00
500 double carbon arc lamps, with globes, at \$25.....	12,500 00
500 lamp hangers, at \$5.....	2,500 00
50 miles of line No. 6 B. & S. weatherproof wire, at 16 cents per pound.....	4,000 00
1,750 cedar poles, with one cross arm, at \$3.....	5,250 00
Setting same, at \$1.....	1,750 00
Insulators and pins.....	150 00
Erecting wire, \$10 per mile.....	500 00
	<u>40,700 00</u>

BUILDING, ETC.—

Building and chimney.....	\$30,000 00
Belting.....	830 00
Pulleys.....	250 00
Shafting, etc.....	500 00
Publishing by-law and incidental expenses.....	1,000 00
Contingencies.....	5,000 00
	<u>37,580 00</u>
Total.....	<u>\$97,130 00</u>

ANNUAL COST OF OPERATING CIVIC ELECTRIC ARC PLANT OF 500 LIGHTS.

Coal, 17,083 lbs. per night, or 3,117 tons per annum, at \$2 per ton.....	\$6,234 00
Carbons, 500 pair per night, at 1½c. per pair.....	2,737 00
Oil and waste.....	300 00
LABOR.—1 superintendent and electrician.....	1,800 00
1 chief engineer.....	900 00
1 assistant engineer.....	700 00
1 fireman.....	600 00
1 dynamo tender.....	600 00
1 lamp repairer and tester.....	600 00
3 trimmers, at \$500.....	1,500 00
2 linemen, at \$500.....	1,000 00
1 patrolman.....	500 00
1 laborer.....	450 00
Keep of 4 horses.....	500 00
Office expenses, stationery, etc.....	600 00
Depreciation, 5% on \$97,130.....	4,856 50
Interest on \$97,130 at 3½%.....	3,399 55
	<u>\$27,277 05</u>
Cost of arc light per annum.....	\$54 55
" " " " night.....	.1493

The following is given as the comparative cost of installing and operating 1,200 and 2,000 c.p. lamps for one circuit—60 2,000 c.p. = 75 1,200 c.p. lamps:

60 double carbon arc lamps, 2,000 c.p., at \$25.....	\$1,500 00
75 " " " " " 1,200 c.p., at \$25.....	1,875 00
MAINTENANCE—	
Carbons, 2,000 c.p. =.....	328 50
Repairs, 2,000 c.p. =.....	65 00
	<u>\$393 50</u>
Carbons, 1,200 c.p. =.....	410 62
Repairs, 1,200 c.p. =.....	93 75
	<u>.503 37</u>

CIVIC INCANDESCENT PLANT.

Following is the additional cost of installing and operating an electric incandescent lighting plant for civic purposes only—1,000 incandescent lights:

STEAM PLANT—Size of engine increased from 500 h.p. to 600 h.p.....	\$1,000 00
Boiler h.p. increased proportionately.....	1,750 00
	<u>\$ 2,750 00</u>
ELECTRIC PLANT—One 50 k. w. = 1,000 light alternator.....	2,500 00
40 transformers, 25 lights, at \$32.50.....	1,300 00
10 miles of feed wire No. 00 B. & S., at \$300 per mile.....	3,000 00
Erecting wire.....	100 00
Belting and pulleys.....	100 00
Cross arms, pins, insulators, etc.....	125 00
Extra poles.....	150 00
Setting same.....	50 00
	<u>\$ 7,325 00</u>
Total.....	<u>\$10,075 00</u>

ADDITIONAL OPERATING EXPENSES.

Coal, 888 lbs. per night, or 162 tons per annum, at \$2.....	\$324 00
Interest on \$10,075 at 3½%.....	352 00
Lamp renewals, sundry expenses, depreciation, etc.....	324 00
	<u>\$ 1,000 00</u>

COMMERCIAL LIGHTING AND POWER PLANT.

At the outset, Mr. Domville states that while the original cost of the installation of an incandescent and arc lighting and power plant for commercial purposes would be high, the city would be more than compensated for the same by the receipts from the sale of light and power. The principal addition to the power station would be the duplicating of the steam plant and the introduction of one alternator, one power generator and one arc dynamo, together with the necessary switchboards and connections. The principal outside item would be the cost of wire, transformers and additional poles required. The addition to the cost of operation would be coal, extra carbons, the employment of two men for indoor wiring, depreciation, and interest on bonds.

The cost of installation and operation of an incandescent and arc lighting and power plant of 3000 incandescent and 125 arc lights, for commercial purposes, in connection with the civic arc plant, is estimated as below :

COST OF INSTALLING INCANDESCENT AND ARC LIGHTING AND POWER PLANT FOR COMMERCIAL PURPOSES.

STEAM PLANT—

One (1) 500 horse power tandem compound condensing engine and condenser erected and connected, ready for operation.....	\$5,000 00
Two (2) 212 horse power boilers, erected and connected ready for operation.....	7,700 00
One boiler feed pump.....	300 00
Contingencies.....	1,000 00
	<u>\$14,000 00</u>

ELECTRIC PLANT, INCANDESCENT—

One (1) 150 kilowatt = 3,000 lights, alternator complete, with exciter and switchboard ..	\$4,000 00
Transformers of sufficient capacity for above.	3,000 00
Approximate cost of line wire, about 25 miles.	9,000 00
Extra poles.....	800 00
Setting same.....	150 00
Erecting wire, \$10 per mile.....	250 00
Belting and pulley.....	200 00
Cross arms, pins, insulators, etc.....	291 00
	<u>\$17,691 00</u>

ELECTRIC PLANT, ARC—

One (1) self regulating series, arc lighting dynamo, 125 2,000 c.p. lights capacity.....	\$2,750 00
125 single carbon arc lamps with globes, at \$15	1,875 00
10 miles line No. 6 B. & S. weatherproof wire, at 16 cents per lb.....	800 00
Insulators and pins.....	20 00
Erecting wire, \$10 per mile.....	100 00
Pulley and belting.....	80 00
	<u>\$ 5,625 00</u>

ELECTRIC PLANT, POWER—

One (1) 100 k.w. multipolar generator, complete with switchboard	\$3,000 00
Belting and pulley.....	200 00
	<u>3,200 00</u>

Total..... \$40,516 00

ANNUAL COST OF OPERATING INCANDESCENT AND ARC LIGHTING AND POWER PLANT FOR COMMERCIAL PURPOSES.

Coal, incandescent plant, 3,555 lbs. per night, or 648 tons per year.....	\$1,296 00
Coal, arc plant, 2,135 lbs. per night, or 389 tons per year.....	778 00
Coal, power plant, 7,110 lbs. per night, or 1,066 tons per year	2,132 00
Carbons, 63 pair per night, 300 nights, at 1½ cents per pair.....	283 50
2 men for indoor wiring, at \$600.....	1,200 00
Interest on \$40,516 at 3½%.....	1,418 00
Depreciation, 5% on \$40,516.....	2,025 00
Lamp renewals and sundries	200 00
	<u>\$ 9,332 50</u>

A rather unique application of electricity has been made at Sacramento, Cal. A Westinghouse alternating current induction motor of 2 h.p. capacity is direct connected to a centrifugal pump. The machines are operated from place to place in the operation of pumping wine from one vat to another. Receptacles for electrical connections are provided at convenient points throughout the winery, and the motor connected by means of flexible cable to the circuit of the Central California Electric Company, whose power is generated 30 miles distant. The motor has neither commutator nor brushes, and there is no connection between the revolving part and the electric current.

DEVELOPMENT OF WATER POWERS.

IN the province of Quebec three projects to develop water powers for the generation of electricity have of late taken definite shape. The most extensive is at Shawenegan Falls, where it is proposed to utilize the water power of the St. Maurice river, at a point where there is a fall of 169 feet. Messrs. A. F. Gault and Mayor Prefontaine, of Montreal, together with other equally well-known capitalists, are the promoters. Tenders were recently invited for the excavation work, power house, etc., and it is understood that the contract has been awarded to Messrs. Barry, Ross & McRae, of Niagara Falls, Ont. The contract, which will occupy several months in completion, represents an amount between \$300,000 and \$400,000, but the total development, including machinery, will cost nearly one million dollars. The scheme also includes the building of an electric railway from Shawenegan Falls to Three Rivers, a distance of 19 miles, and the transmission of the power to the latter place.

The contracting firm of Barry, Ross & McRae are also engaged on the hydraulic work of a development scheme at St. Catharine, 16 miles from the city of Quebec. The promoters are chiefly New York capitalists, Mr. E. W. Cooke, of that city, being the general manager. The proposed point of utilization is a fall on Jacques Cartier river at the outlet of Lake St. Joseph. The company will enter the city of Quebec in the same way that the Lachine Rapids Co. entered Montreal. In both cities existing companies thought they had monopolies, but some years ago the Standard Electric Company was incorporated by the legislature with most extraordinary powers. One of them was that it could supply electricity to any plant in the province and make the constructions necessary for such purposes. The Standard charter was absorbed by the Lachine Company, which was thus enabled to defy opposition and enter Montreal. The Lachine Company, or rather the Standard Company, has now sold a similar privilege to the Jacques Cartier Company for the sum of \$8,000, and the latter will be able to enter Quebec. The company also intends to utilize part of its power in the manufacture of pulp and paper, and to erect factories on the same scale as those erected by the Laurentide Pulp Company at Grand Mere, on the St. Maurice river.

The Canadian Electric Light Co., of which Mr. Wilson Smith, of Montreal, is president, will undertake the third project to which we refer, the Chaudiere Falls, near Quebec, being the point of development. It is proposed to light the town of Levis, to pump water for it from the St. Lawrence, to generate electric light for the cars of the Intercolonial and other railways at Levis, and to cross its wires into Quebec as well. It is estimated that the falls will give 5,000 horse power.

The Metropolitan Electrical Company of Ottawa, Limited, have made application to the Dominion government for a charter of incorporation. The capital stock of the company is placed at \$500,000, and the provisional directors are: Thomas Lindsay, merchant, William Arnold and A. B. Broderick, of Ottawa, and James Robinson and Frederick Cains, of Montreal. It is proposed to engage in a general electric light and power business. The company are taking tenders on the supply of 4,000 poles. They have purchased a water power at Britannia from Mr. J. R. Booth. Mr. John Aylen, hydraulic engineer, has made an estimate of the water power available, which he gives as 40,000 horse power. Mr. Aylen will supervise the rebuilding of the dams, which he hopes to have completed by next spring.

MONTREAL.

(Correspondence of the CANADIAN ELECTRICAL NEWS.)

NEW ELECTRICAL EQUIPMENT AT MCGILL.

THANKS to the munificence of Mr. W. C. McDonald, who recently gave \$30,000 for the purpose, the Electrical Department of McGill University is being newly equipped with thoroughly up-to-date electrical apparatus for experimental purposes. The new apparatus, most of which has already been purchased, will comprise the following :—

One 100 h.p. high speed single cylinder side crank engine, 200 11 E. chloride cells, one m.p. 75 k.w. 125 volt direct current dynamo, one m.p. 30 k.w. 500 volt direct current dynamo, one m.p. 40 h.p. 125 volt direct current motor, two m.p. 25 h.p. 125 volt direct current motors, two m.p. 20 h.p. 125 volt direct current motors, two m.p. 15 h.p. 125 volt direct current motors, two m.p. 10 h.p. 125 volt direct current motors (the motors are compound wound, with shunt to series turns to vary degree of compounding, and with shunt rheostat to vary speed); one 6-pole 25 k.w. 220 volt revolving field A. C. generator, arranged to deliver single, two or three-phase currents, one two-phase 20 k.w. inductor alternator, one single phase 15 k.w. inductor alternator, two single phase induction motors, one 15 k.w. rotary convertor, one capacity set, one 10 h.p. induction motor, arranged to be used either as two or three-phase machine, with secondary provided with collector rings, so that motor can be used as frequency changer, three 3 k.w. potential regulators, two 5 k.w. 2-phase 3-phase transformers, one phase shifter, one 1 k.w. constant current transformer, five current transformers, one special transformer for A. C. ammeter testing, one 2 h.p. two-phase induction motor, one 200,000 volt testing set, one motor dynamo with double field for battery charging, one motor dynamo with double field for instrument calibration, two small synchronising motors, one electric welding outfit, one electric plating and typing outfit, four electric speed indicators, one laboratory standard volt-meter, one laboratory standard ammeter, one continuous rheostat, one potentiometer, ten standard cells, thirty volt-meters, ammeters and watt-meters, for general laboratory use, thermometers, one photometer and attachments, one conductivity bridge, two standard megohms, one standard condenser, one hysteresis tester, and various fittings and attachments.

The principal laboratories are: Dynamo laboratory, standardizing laboratory, laboratories for advanced investigation.

A 75 k.w. direct connected unit will be installed in the service plant for current supply, and a 75 k.w. hour storage battery in three sections in battery room, adjoining laboratory. There will be a distributing board for 36 circuits. It has been decided to abolish shafting in the dynamo laboratory; every machine will have a separate motor for driving. None of the machines will be fixed permanently in place, but will be mounted on testing blocks, so that they may be readily moved from place to place, for which purpose the laboratory will be equipped with travelling cranes. The low voltage A. C. machines will supply two and three-phase current. Permanently wired testing tables will be used to facilitate work. The standardizing laboratory contains all instruments necessary for the accurate measurement of electrical and magnetic quantities. The new equipment is expected to be in working order on the re-opening of the school after the New Year vacation, although a longer period will be required to thoroughly complete the work.

Prof. Owens, who has recently been appointed head of this important department, has already shown himself to be possessed of a great deal of energy, and is setting a high standard for his department, which he will spare no effort to achieve. He has already arranged for visits of inspection by his students to some of the leading electrical manufactories and installations. A visit of this character was recently made to the Royal Electric Company's works and lighting stations in this city, and another will shortly be paid to the works of the Canadian General Electric Company at Peterborough, Ont. Following this, the power transmission works at Chambly and other important plants will be inspected. Great benefit must accrue to students who are thus brought in contact with the practical application of the science. It is understood to be the purpose to supplement this by a series of lectures during the coming winter by well-known electrical authorities. It is gratifying to learn that the attendance of third and fourth year students is double what it has been in former years.

LACHINE RAPIDS HYDRAULIC AND LAND COMPANY.

Mr. Wallbank informs me that his company have just received the contract for lighting the city and suburban depots and workshops of the C. P. R., and that during the last month they have made contracts for upwards of 4,000 lights, including the new theatre on Guy street, which will be the first building to be served from an underground conduit connected with the terminals of the transmission line from Lachine.

ELECTRICITY IN COPPER MINING.

Experiments are to be made with a view to the introduction of electricity for lighting the copper mines of the Eustis Mining Co. These mines are situated at the town of Eustis, on the Boston and Maine Rail-

road, about a mile from Capleton, Que. The Eastern Townships Electric Light, Power & Carbide Co., who operate an electric plant at North Hatley, are already supplying light to the houses and other buildings at the mines, and, as stated, the company are negotiating with the company to light the mines also, for which purpose about 200 lights would be required. There is a difficulty in the way, however, which it is hoped may be overcome. In the mining of the copper, sulphuric acid gas is liberated, and its action upon electric wires and other metals is so destructive that unless means can be found for their protection the equipment would be rendered useless in a very short period. An iron smoke stack has had to be replaced by one of clay, owing to the action of the gas. In connection with the proposal to light the mines by electricity, experiments are about to be made with special forms of insulation which it is believed will suffice to protect the conductors.

NOTES.

The machine tools in the new workshops of the Central Quebec Railway, opposite Sherbrooke, Que., are to be operated by direct-connected electric motors.

The Chambly Manufacturing Company's power and light transmission plant is rapidly approaching completion. The generators are in working order, the transmission wires are being strung, and a transformer station is nearing completion at the Royal Electric Company's works on Queen street. The current will here be reduced from 12,000 to 2,000 volts.

Messrs. W. W. Gamwell and Henry E. Hine, president and general manager respectively of the Stanley Electric Manufacturing Co., of Pittsfield, Mass., were in Montreal last week. Accompanied by Mr. W. H. Browne, general manager of the Royal Electric Co., they visited Chambly and inspected the works of the Chambly Manufacturing Co. They afterwards spent a day in Quebec.

The Dominion Cotton Mills Company are now operating one department of their factory by electricity, a 250 h.p. motor being employed for the purpose. It is the intention ultimately to operate the whole of the works by electric power. Every precaution is being taken against fire, in view of the combustible nature of the manufacturing material. With this object, towers are being built separate from the main building, in which the motors will be installed. The electrical work is being carried out under the direction of Mr. P. G. Gossler, of the Royal Electric Co.

INSPECTION OF ELECTRICAL WORK IN WINNIPEG.

FOLLOWING is a copy of a by-law recently passed by the city of Winnipeg, Man., providing for the appointment of a city electrician and for the inspection and regulation of electrical apparatus:

INSPECTION AND REGULATION OF ELECTRICAL APPLIANCES.

There shall be an inspector of electrical installation and appliances for the city, who may be called the City Electrician, and until further or other appointment the chief of the fire brigade shall be such City Electrician.

ELECTRIC CURRENT.—No electric current shall be used for illumination, decoration, power or heating, except as hereinafter provided.

APPLICATION, CONTENTS, PERMITS.—All persons, firms or corporations desiring to install wires or other apparatus for the use of electric currents for any of the purposes mentioned in the preceding section of this by-law shall, before commencing or doing any electrical construction work of any kind whatever, either in installing new electrical apparatus or repairing apparatus already in use, file an application for a permit therefor with the City Electrician, which application shall describe in detail such material and apparatus as it is desired to use, with a full description of the same, giving the locality by the street and number; and upon receipt of such application, if found proper, such permit shall be given.

DUTIES OF CITY ELECTRICIAN.—The said City Electrician shall then have power, and it shall be his duty when by him deemed necessary, to carefully inspect any such installation previous to and after its completion, and it shall be competent for him to remove any existing obstructions which may prevent a perfect inspection of the current carrying conductors such as laths, plastering, boarding or partitions; and if such installation shall prove to have been constructed in accordance with the rules and requirements of the fire department of the city, and the rules and regulations forming part of this by-law, he shall issue a certificate of such inspection, which shall contain a general description of the installation and the date of such inspection. The use of electric current is hereby declared to be unlawful previous to the issuance

of said certificate, provided however, the City Electrician may issue a temporary permit for the use of electrical current during the course of construction or alteration of buildings, which permit shall expire when the electrical apparatus for such building is fully installed.

PRELIMINARY AND FINAL CERTIFICATE.—A preliminary certificate may be issued by said City Electrician in the case of completed installations, but upon which no current will be used in the immediate future. Such preliminary certificate shall show that at the date of inspection the installation was erected in accordance with the terms of this by-law. Prior to the introduction of electric current into the said premises, a second inspection shall be made, when, if the said installation is still in accordance with the terms of this by-law, a complete and final certificate shall issue. Any owner or owners of property installing electric wires to be hidden from view shall, prior to such installation, give said City Electrician a reasonable notice in order to give ample time for inspection.

POWERS OF CITY ELECTRICIAN—PENALTY.

The said City Electrician is hereby empowered to inspect or reinspect all overhead, underground and interior wires and apparatus conducting electric current for light, heat or power, and when said conductors or apparatus are found to be unsafe to life or property, shall notify the persons, firms or corporations owning, using or operating them to place the same in a safe and secure condition within forty-eight hours. Any person, firm or corporation failing or refusing to repair, change or remove the same within forty-eight hours after the receipt of such notice, shall be liable to a penalty of \$50.

POLES, COVERS, WIRES, BRANDED AND TAGGED.—All poles now standing or hereafter erected, and all covers for manholes now in service, or hereafter placed in service for the use of electric conductors, shall be branded or stamped with the name of the person, firm or corporation owning the same; and all electric service entrances shall have attached to the conductor or conductors, in a conspicuous place, a substantial tag designating the owner of, and giving such a full description of the conductors as shall meet with the approval of said City Electrician.

RECORD, ANNUAL REPORT.—It shall be the duty of the said City Electrician to keep records containing a full and accurate account of all inspections made and of all moneys received; he shall annually on or before the first day of February in each year, prepare and present to the city council a report showing the entire work of his department during the previous calendar year; and he shall at the same time send to the comptroller a full and comprehensive statement of all matters pertaining to his department, together with an estimate in detail of the appropriations required by the department during the next municipal year.

ALTERATIONS.—No alterations shall be made in any installation without first notifying the said City Electrician and submitting the same for similar inspection, as above provided.

PENALTY.—Any person or persons who shall use electric current in violation of any of the provisions of this by-law shall be subject to a penalty of fifty dollars. Said City Electrician may for any violation of this by-law order and compel the cutting off and stopping such current until the provisions of this by-law are fully complied with.

The schedule of rules and regulations governing electrical work, as adopted by the Canadian Fire Underwriters Association, is also given as a part of the above by-law.

WIRELESS TRANSMISSION.

"THE Electrical Transmission of Messages without Wires" was the subject of a lecture delivered before the Applied Science Society of McGill University, Montreal, recently by Professor Rutherford, McDonald Professor of Physics, who has done much original research along that line.

The subject, Professor Rutherford said, was still in its infancy, and it would probably be many years before it would be applied to practical use, if, indeed, it ever would be. Dealing with the history of the subject, he said that over twenty years ago Prof. Clark Maxwell pointed out the similitude existing between electrical vibrations and light waves. Prof. Hertz, of Bonn Uni-

versity, however, was the first to actually demonstrate the similarity of the two waves. Until Prof. Hertz's time, electrical waves were known to exist, but had not been detected; he, however, in a wonderful series of experiments, detected these waves, and showed that in their behavior they acted exactly like light waves, except that they had a greater wave length. The lecturer then explained at some length the method used by Hertz to show the presence of these electrical vibrations.

From 1888 to 1894, he went on, much work was done with regard to electrical waves, and upwards of twenty different means of showing their existence were devised. Professor Lodge, in the course of experiments carried on in this direction, discovered that the passage of an electrical current between two knobs caused cohesion, and as a result of this discovery he devised what is known as the coherer, the most delicate means of detecting electrical vibrations.

Professor Rutherford then explained minutely the principle of the coherer, and successfully demonstrated its remarkable action by means of the light spot of a galvanometer. An instrument invented by the lecturer was next explained, in which fine steel wire took the place of the iron filings of the coherer, and acted by demagnetization. This instrument was so small that its entire length was not over one-third of an inch, and its thickness did not exceed that of an ordinary knitting needle. With this he had, in Cambridge, detected electrical vibrations at a distance of half a mile.

The more recent work of Marconi, a student of Bologna, was then dealt with. With the aid of Sir Wm. Preece, of the English post office, Marconi conducted an elaborate series of experiments, all based upon the use of the induction coil and coherer. By means of these he detected and recorded electrical vibrations at distances up to ten miles, and with very minute efficiency up to 20 miles.

By means of a decoherer, such as an electrical hammer, the recording of these vibrations could be used as a telegraphic code, and this is all that has so far been achieved in the matter. In conclusion, Prof. Rutherford dealt with the future possibilities of electrical transmission without wires. He thought that ten miles, the distance achieved by Marconi, was in all probability the limit, as the distance through which the waves can be detected is very much in proportion to the size of apparatus used, and Marconi is now using the largest instrument possible. As there has not, so far, been devised any means of controlling the vibrations, which must be sent out in every direction, messages sent must be, in a measure, public property. It is, nevertheless, possible that a reflector may yet be devised, which will act for the electric wave in the same way that the parabolic mirror does for light waves. In the case of electrical vibration, however, the mirror would have to be carried out on a very much larger scale.

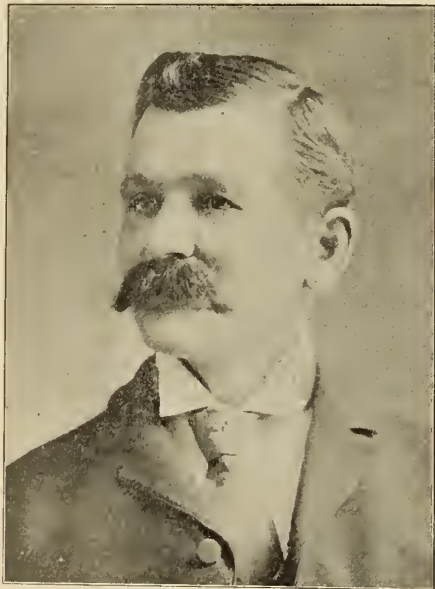
A discussion followed the lecture, and was joined in by some of the professors and students present. During this, the blowing up of the powder magazines of warships by means of an electrical wave was referred to. Professor Rutherford reassured his audience upon this most interesting point, by stating that he did not think it possible that an electric wave could penetrate a properly closed vessel.

A donation of \$30,000 is said to have been made recently by Mr. W. C. McDonald to the Department of Electrical Engineering at McGill University, Montreal.

ENGINEERING PLANT IN FREEHOLD LOAN COMPANY'S BUILDING.

ONE of the largest and most modern office buildings in Canada is that of the Freehold Loan and Savings Company, corner Victoria and Adelaide streets, Toronto, the engineering plant in which is under the superintendence of Mr. James Huggett. A few particulars of this plant, as gleaned from a personal inspection, may be interesting. The building is lighted by electricity, but gas may also be used if necessary. It is said that the wiring of the building for electric lighting cost upwards of \$4,000. The elevators are hydraulic, of improved design, and the best that could be purchased, being capable of operating at a speed of 700 feet per minute, but the usual speed is scarcely above 450 feet per minute. The elevators, boilers, pumps, plumbing, steam heating, etc., cost in the neighborhood of \$50,000, the Bennett & Wright Company being the contractors for plumbing and steam fitting.

All power is generated on the premises, the boiler capacity being capable of developing 200 horse power. Both water tube and tubular boilers are used. These



MR. JAMES HUGGETT.

are so arranged as to heat the building by low pressure, at the same time carrying high pressure for power purposes. The exhaust steam is used for heating the building, and returns are controlled and pumped back to the boilers. There are seven steam pumps, of all sizes, from 22 gallons to 500 gallons capacity per minute, manufactured by the Northey Company, of Toronto; one large compound pump weighing five tons. The capacity of the pumping plant for elevators alone is nearly three-quarters of a million gallons per day. There is an auxiliary pump for elevator service, which is used for heavy lifts. Smaller pumps are provided for other purposes, including an air pump in connection with temperature regulation. The temperature in each room is regulated by what is known as the Johnson electric air pressure controller, having thermostat in each room and diaphragm over each end of radiator to control the valves, which has been found to be a great convenience to tenants. This system is controlled from the boiler room, where electric batteries, air pump, etc., are placed, and in the hands of the present superintendent has been a complete success. All water is filtered by a large filter with a capacity of 200,000 gallons per day, and hot water is supplied to all parts of the building.

The building is heated by steam by direct and indirect radiation, both systems being controlled. The ventilation of the building appears to be first-class, the method adopted being to bring in fresh air and take out foul air by a large fan placed on roof and operated by steam power. Fire protection is also provided by a stand-pipe and branches on each floor, with hose to reach to any part of the building, while a fire brigade, well drilled, reduces the danger of fire to a minimum. The fire system has also been connected with the pressure tank at top of building, so that at any time the large pumps in the basement may be started, thus, in case of fire, providing greater pressure than can be obtained from the city water service.

Mr. James Huggett, the chief engineer, whose portrait we present, has had charge of this plant since it was installed, and, by the aid of his assistants, keeps the building and equipment in first-class condition. Indeed, the general appearance of the building is often favorably commented upon by visitors. Mr. Huggett, for a number of years, has been a member of the Canadian Association of Stationary Engineers, and for some time past chairman of the Trustee Board. For three successive years he has been elected a delegate to the annual convention, showing the esteem in which he is held by his brother engineers. He was born in Chatham, Kent, England, where he obtained his first engineering experience, at the Naval Dock Yard. He has resided in Canada for the past twenty-eight years, during which time he has gained much practical experience. Before coming to Toronto to accept his present position, Mr. Huggett was for fifteen years in the employ of the A. S. Whiting Mfg. Company, of Oshawa. His present duties include the general superintendence of the building as well as of the engineering plant, and he has proved himself to be the right man in the right place.

MOONLIGHT SCHEDULE FOR DECEMBER.

Day of Month.	Light.		Extinguish.		No. of Hours.
		H. M.		H. M.	
1....	P. M.	5.00	P. M.	9.00	4.00
2....	"	5.00	"	9.40	4.40
3....	"	5.00	"	10.50	5.50
4....	"	5.00	"	11.50	6.50
5....	"	5.00	A. M.	12.50	7.50
6....	"	5.00	"	1.50	8.50
7....	"	5.00	"	3.00	10.00
8....	"	5.00	"	4.00	11.00
9....	"	5.00	"	5.00	12.00
10....	"	5.00	"	6.00	13.00
11....	"	5.00	"	6.20	13.20
12....	"	5.00	"	6.20	13.20
13....	"	5.00	"	6.20	13.20
14....	"	5.00	"	6.20	13.20
15....	"	6.20	"	6.20	12.00
16....	"	7.40	"	6.20	10.40
17....	"	8.50	"	6.20	9.30
18....	"	9.50	"	6.20	8.30
19....	"	11.00	"	6.20	7.20
20....	"	11.00	"	6.20	7.10
21....	"	11.40	"	6.20	6.40
22....	"	5.00	"	6.20	13.20
23....	"	5.00	"	6.20	13.20
24....	"	5.00	"	6.20	13.20
25....	No Light.		No Light.		....
26....	No Light.		No Light.		....
27....	No Light.		No Light.		....
28....	No Light.		No Light.		....
29....	P. M.	5.10	P. M.	10.00	4.50
30....	"	5.10	"	10.00	4.50
31....	"	5.10	"	10.00	4.50

Total..... 253.40
Grand Total...2208.00

The Canadian General Electric Company have sold an electric plant to the Oxford Mfg. Co., of Oxford, N.S.

MACHINERY BEARINGS.

ANY mechanic will inform you that the common plumber-block should be a little easy at the sides, and that the bearing should receive oil from the top. He seldom knows the reason for this rule, however, and though his ignorance does not prevent his mill shaft bearings running cool, not "knowing why" makes him experience trouble with many bearings not so simply loaded.

John Dewrance, in a paper on the subject, detailed experiments which ought to clear ideas and rectify erroneous practices.

Bearings were clamped upon a shaft so that the load upon its underside was this same clamping pressure, while on the top this was augmented by weight of brasses, clamps and springs.

An oil hole at the top refused entirely entry to oil, which could be given, however, at either side. The bearing—which ran fairly cool—ejected oil under a pressure of 2,300 lbs. per square inch through the upper oil hole. The bearing was then taken out and surface dressed in order to obtain still greater pressures; but when replaced, instead of this great positive ejecting pressure, there was a suction at the upper oil hole measured by a vacuum gauge at thirty inches; the whole still running cool and well. The blocks when taken out showed at first sight no explanation for so great a change in pressure, but close examination made the matter clear. The under side of the top brass at first was not quite flat, the central portion taking all the load; this sprung the brass and ground the central part; so, when replaced under diminished load, there was a vacant space around the oil hole, where formerly had been the greatest pressure.

In any bearing to run cool and well means that a film of oil keeps forcibly apart the sliding pieces. The total pressure on this oil must be the total load. The surface tension of the oil and capillarity alone provide the power the oil has to resist this pressure, therefore the pressure is the greatest where space between the surfaces is least. And since, moreover, oil is carried on by sliding, it follows that to keep up the supply the space must taper to the point of greatest pressure.

If we lay a flat plate on a well oiled shaft, and gauge the pressure at a hole drilled through it, as we approach the point of nearest contact pressure will rise, to fall again—and fall down below zero as we pass it.

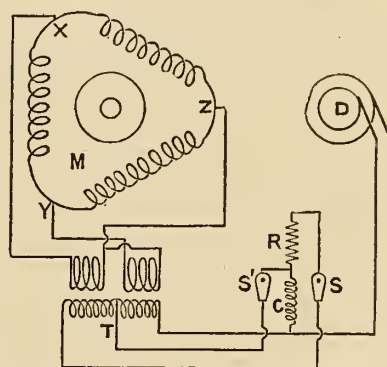
Tapering spaces must then be provided in all our bearings of this class; and oil supplied at that point where the load is least. The series of experiments referred to was first taken up in order to discover whether "brasses" of different metals differed in their capacity for bearing loads without increase or friction. As one might have anticipated, it was found that no such difference existed; so long as a sufficient film of oil remains it matters little—in this connection—what the metals are. Given that they are strong and stiff enough the one great point is that the bearing should be softer than the shaft; for then at times of failure in the oiling the shaft is coated with the scraped-off softer metal, more or less evenly around its surface. But if the shaft should be the softer of the two, its heaped-up scraping will accentuate local unevenness in the bearing.

The main point in the paper is, however, the light thrown on the simple point of oiling. In ordinary mill shaft plumber blocks this is done rightly from the top. At first our railway axle bearings were likewise—but

wrongly—fed; that fault was soon detected and set right; but still mechanics' ignorance upon the subject causes much trouble with some engine bearings; and since it is a fact that pressures over one ton per square inch can be endured by properly constructed brasses, while costly troubles are often caused by far less loads, the question certainly deserves attention until our errors are set right.

PHASE TRANSFORMERS.

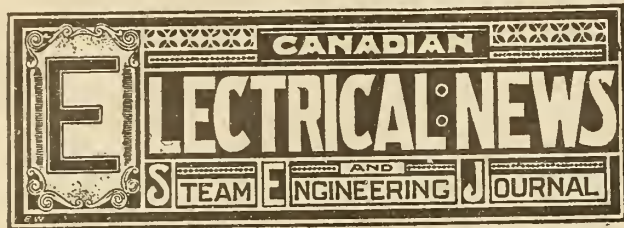
THE usefulness of some simple form of phase transformer enabling single-phase currents to be split up into polyphase currents, and thus permitting the use of a simple conducting system of one wire, would be especially appreciated in the field of railway work, where any attempt to use polyphase currents for power purposes is met at the outset with the difficulty of a double trolley system. In a very valuable paper in *Zeitschrift für Elektrotechnik*, Herr Gustav W. Meyer discusses all the forms of phase transformers, with special reference to



this application. An ingenious device for operating a three-phase motor on a single-phase current supply is illustrated above. The motor, M, has the usual field winding and a three-phase winding on its rotor. The stator is connected as shown to the two ends and the middle point of the secondary of an ordinary split transformer, and in the primary circuit with this is connected a non-inductive resistance, R, and a self-induction coil, C, as shown. By the switches, S and S', these can be cut in or out of the circuit. At starting they are cut in, as shown, and produce a sufficient displacement of phase to start the motor. After the motor attains speed the switches are opened, and the reaction of the three-phase winding on the rotor induces a current in the part X Y of the stator winding, the machine continuing to run as a three-phase motor, though supplied with single-phase current. The American Electrician says that it is claimed that this method surpasses the rotary phase transformer of Arno and Ferraris, on account of its simplicity and cheapness and absence of moving parts.

RECENT CANADIAN PATENTS.

PATENTS for the following electrical and engineering devices have been granted in Canada: A. F. Hack, Melbourne, Aus., steam boiler furnace arch; American Electric Heater Co., Detroit, Mich., electric heater; M. E. Thompson, Ridgeway, Penn., and Charles L. Cornell, Hamilton, Ohio, dynamo electric machine; Theophilus D. Farrell, London, Eng., electric lamp; Philip H. Patriarche, Toronto, street annunciator for cars; John F. Lister and Wm. S. Chamberlain, Cleveland, Ohio, incandescent lamp; Charles M. Gould, assignee of Wm. F. Richards, Buffalo, electric lighting apparatus for railways; Electrical Vehicle Syndicate, London, Eng., electric carriage safety device; Charles T. Monroe, Silas C. Dishno and Narcisse Deloge, Jackson, Montana, water wheel; O. H. Michaelson, Charleston, U.S., electric lamp; Alex. H. Canning, Toronto, rotary engine; Geo. M. Lane and Elisha Stout, electric arc lamp; John Abell, Toronto, engine cut-off.



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EDITOR'S ANNOUNCEMENTS.

Correspondence is invited upon all topics legitimately coming within the scope of this journal.

The "Canadian Electrical News" has been appointed the official paper of the Canadian Electrical Association.

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Appointment of City Electricians.

Electrical companies will welcome the growing disposition on the part of municipal authorities to appoint properly

qualified electricians to protect the interests of municipalities in the matter of electric wiring and other electrical work. The municipalities are realizing that this course is, in the end, the most economical, while encouragement is also being given by the electrical companies, who will no longer be called upon to execute unnecessary work, as is often the case when the decision of an incompetent and inexperienced person is allowed to govern work of this description.

Efficiency of Coals.

A REPORT on the steam-making value of coals has been issued by the Boston Mutual Boiler Insurance Company, by which it is shown that a large quantity of stone and dirt is mixed with nearly every variety of coal, thus reducing its efficiency. Tests of samples of coal as delivered by dealers showed proportions of earthy and stony matter varying from one and one-half to forty-six per cent. Taking the principal varieties of coal as burned in the Eastern States, the consulting engineer of the company found that, rating the evaporative power of Cumberland coal at one hundred as the standard, the comparisons were as follows: Pocahontas coal, 102; Clearfield, Wyoming, New River and Lykens Valley coal, 97 to 98; Schuylkill, 95; Lehigh, 93; Nova Scotia, 85. The average percentage of ash was: New River, 5½ per cent.; Cumberland and Pocahontas, 7½ per cent.; Clearfield and Nova Scotia, 10 per cent.; other qualities, from 15 to 18 per cent. The anthracite coals were found to be much less clean than the soft coals. Subtracting the ash, so as to compare results for the combustible portion of the coal, there is little difference between the heating power of the various classes, the

Nova Scotia—the lowest on the list—rating only a trifle below Lehigh, and but ten per cent. below Cumberland and Pocahontas, which are the highest. As the cost of shovelling coal into a furnace, and of removing ashes and cinders, is an item of considerable expense in operating a steam plant, it becomes the duty of the manager thereof to give strict attention to the quality of coal burned.

Electrical Water Power Developments.

IF indications count for anything, the utilization of water powers for the development of electricity is only in its infancy in Canada. Recent years have witnessed the harnessing, for electrical purposes, of several large water powers, while in some instances skilful engineering has permitted of comparatively small water powers being used, under a high pressure, to develop a considerable output of current. These conditions, so widespread throughout Canada, would, as stated, indicate their future utilization on a large scale. The extent of this development will depend, almost entirely, upon the demand for electricity for light, heat and power purposes. As to the former, there are numerous municipalities which would, without doubt, welcome the advent of electric light, but which are too small to support a private company. This business might be secured, with profit, by a company operating long distance circuits and supplying a number of municipalities. For heating purposes the use of electricity is steadily increasing, but being looked upon as an innovation, we do not anticipate an immediate extensive demand for its use. It is in the direction of furnishing power for manufacturing establishments that we look for the widest field for electrical transmission plants. Canada is becoming more and more of a manufacturing country, and capitalists are being attracted here as a promising field for investment. The number of water power development projects that have already taken definite form is in itself significant. The most important is at Shawenegan Falls, Que., where the water of the St. Maurice river is to be utilized to develop 30,000 horse power to operate pulp mills, saw mills, factories, etc., at Three Rivers and other places. Near the city of Quebec there are two projects to be carried out, on one of which work is now progressing. At Port Arthur, Ont., Mr. E. S. Jenison is negotiating, with good prospects of success, for the development of the water power of the Kakabeka Falls, on the Kaministiquia river, and transmitting the electricity to Port Arthur and Fort William, at an estimated cost of one million dollars. Similar undertakings are contemplated at Grand Falls, N.B., and in British Columbia, all of which bear testimony to the improved conditions now prevailing in Canada.

CANADIAN ELECTRICAL NEWS STUDENTS' COMPETITION.

IN pursuance of the preliminary notice published last month, we had hoped to be able to announce in this number full particulars of the competition which the publishers of this journal propose to institute among the electrical students in Canadian colleges. While progress has been made with the details, it has been found impossible to complete all the arrangements, and we must ask readers who may be interested to await the publication of our December number, in which the terms of the competition will be fully explained.

HAMILTON ELECTRIC LIGHTING REPORT.

PARTICULARS of the report of Mr. Percy Domville to the council of the city of Hamilton, as to the cost of lighting the city by a plant to be owned and operated by the corporation, are given elsewhere in this number. The report goes pretty fully into the various items which enter into the determination of these costs, with the result that the citizens of Hamilton are assured of their lighting being done for \$54.55 per 2000 c.p. lamp per year for all night running. It may be of interest to refer to some of the salient features of the report. Looking at the figures, we are interested in knowing that one 500 h.p. tandem compound condensing engine, with condenser, is to be used, and can be erected and connected in running order, with foundations complete, for \$5,000, and to be of such a superior type, apparently, as to obviate all chances of breakdown, as no allowance is made for another engine to cope with such an emergency. The simplicity and cheapness of this single unit and faith system will appeal to the average station manager whose contract depends upon the ability of his plant to keep the lights running every night and all night.

It will be observed that in the operating expenses the largest item is that for coal, which can be laid down at the furnace doors apparently for two dollars per ton, which it is probably worth, as we are assured that one pound will give 140 watt hours at the lamp, with four pounds consumption per h.p. and with 90 per cent. efficiency in engine and arc dynamos, and 93 per cent. in line. The experienced station manager, accepting the coal consumption given, would figure about as follows: Engine, 90 per cent. efficiency; arc dynamos, 88 per cent. (that being the maximum claim made by the makers); countershaft efficiency, 90 per cent.; belting, 95 per cent.; line, 93 per cent. as before. This gives 118 watts per pound, instead of 140, increasing the coal consumption by 15 per cent. The experienced manager would also make an allowance of about 10 per cent. for banking or starting fires and to cover shrinkage in the coal pile, all of which he has to pay for, thus increasing the coal cost by 25 per cent.

The next largest item is depreciation, at 5 per cent. We welcome this figure as indicating a recognition of the fact that depreciation of a municipal plant does exist, it being frequently omitted altogether in such reports. As no other allowances are made, we infer that this five per cent. is intended to cover repairs, antiquation and possibly insurance, as well as the depreciation due to gradual wearing out. Most authorities would consider that 5 per cent. on buildings, 7 per cent. on steam machinery, and 10 per cent. on electrical apparatus, pole lines, etc., would be a very modest estimate to cover these items, which are placed by Mr. Domville at 5 per cent., and to be safe they would figure interest and depreciation on extra engine in case of trouble. Considering only these three items of cost, coal consumption, depreciation and an extra engine as above indicated, we find that the cost per lamp has gone up from \$54.55 to \$64.30. We need scarcely enquire further into the costs, the unreliability of the above items indicating what may be expected of the others. We observe, however, that no allowance is made for stock of coal, wire, poles, extra lamps, etc., which must be kept on hand, nor for meters,

transformer erection, and many other items which appear against the capital account of the ordinary station. The solitary dynamo tender provided for in the estimates has our sympathy. He will have on his hands the complete responsibility of the operation of a five hundred light plant. His shift will be 16 hours long during the winter months, for seven days per week, and presumably he will have to spend a portion of the remaining eight hours of the 24 in adjusting and making small repairs to the machines in his charge. We think that services of this kind merit more reward than \$600 per year.

Seriously, we hope, for the reputation of all concerned, that the Hamilton authorities will look more carefully into the matter, and not be led to expect impossibilities, even when backed up by nicely arranged figures. This report is typical of that class of statements by means of which municipalities have been induced to undertake responsibilities with which they were not familiar, and frequently with disastrous results. In drawing up a report of this kind, it is comparatively easy to figure the cost of a system ready to run, but it requires a thorough knowledge of operating conditions to predict with any certainty the operating costs, and, as in this case, it is in this respect that many such reports are unreliable. We do not wish to be understood as condemning every case of municipal control off-hand, but we do say that in the majority of cases it has been found to be a mistake. Given the same system under municipal and under private control, and assuming that the management in both cases has the same dividend making efficiency, the former will have an advantage, for whereas the municipal plant is capitalized on money borrowed at 3.5 per cent., the private plant is expected to pay, say, 8 per cent., and the difference of 4.5 per cent. is in favor of the first. Again, a new municipal plant properly engineered and managed, has, by reason of its greater efficiency of operation, a decided advantage over an old and inefficient plant which it is to replace; but old age comes to even the municipal plant, and in ten or fifteen years consigns it to the scrap heap, and depreciation to correspond must be allowed. In any case, the difference in cost of operation will not be so great but that by improper management the positions may be reversed, and municipal management, hampered as it usually is by local politics, is not in the best position to make the most of the above advantages. It is to be hoped that before taking action upon the report the authorities of Hamilton will submit it to competent criticism.

THE OLDEST STEAM ENGINE.

THE oldest engine in the world is in the possession of the Birmingham Canal Navigations in England, and was constructed by Bolton & Watt in the year 1777, the order being entered in the firm's books in that year as a single acting beam engine, with chains at each end of a wood beam, and having the steam cylinder 32 inches in diameter, with a stroke of 8 feet, and erected at the canal company's pumping station at Rolfe street, Smethwick. During the present year this remarkable old engine, which has been regularly at work from the time of its erection to the current year, a period of, say, 120 years, was removed to the canal company's station at Ocker Hill, Tipton, there to be re-erected and

preserved as a relic of what can be done by good management when dealing with machinery of undoubted quality. It is worthy of note that the Birmingham Canal Navigations favored Bolton & Watt, in 1777, with the order for this engine, and, in 1898, or 120 years afterward, the company have entrusted the same firm, James Watt & Co., Soho, Smethwick, with the manufacture of two of their modern triple expansion, vertical engines, to be erected at the Walsall pumping station, having 240 horse power and a pumping capacity of 12,713,600 gallons per day.

TRANSMISSION SCHEME AT GRAND VALLEY.

THE opening of a thirteen mile transmission line for electric lighting purposes only between Grand Valley and Arthur, Ontario, marks a new era in electric lighting in Canada. The village of Grand Valley is situated on the Canadian Pacific railway, about 100 miles from Toronto, and has a population of 800 people. The residents of this village desired electric lighting, but the municipality was rather small for the investment to be made for electric lighting only. However, Mr. John Philip, who owns and operates a saw mill at Grand Valley, was enterprising enough to give the people incandescent electric lights. For this purpose he installed in his saw mill an S.K.C. two-phase generator with a capacity of about 750 or 800 incandescent lamps. He found that after supplying the wants of Grand Valley, he still had a capacity to spare on his dynamo, engine and boiler of about 400 lights, and as the electric lighting at Grand Valley was not sufficient to pay him a fair income on the money invested, he cast about for other means of utilizing the current. He consulted one of the engineers of the Royal Electric Company, who suggested the idea of transmitting the current from one phase of his machine to the village of Arthur, about 13 miles distant, and using the other phase for the lighting of Grand Valley.

When the scheme was mooted and the people of Arthur approached on the subject, they were willing to fall in with the idea, but were very doubtful if the current could be carried that distance; in fact, some electricians laughed at the idea. Nevertheless, Mr. Philip being a sturdy Scotchman, and having confidence in his advisers, undertook the work, and on the evening of October 20th the lights were turned on in the village of Arthur, and have been in operation since that time.

The entire loss in the transmission is said to be less than 5 per cent., and the lights are equally as good in Arthur as they are in Grand Valley, close to the machine. In this way Mr. Philip has converted a non-earning property into one which will in future pay him a handsome sum.

There are many existing plants in Ontario now which could, in the same manner, increase their revenue, and we would commend this installation to their careful consideration. The conception and carrying out of this work is certainly a credit to the Royal Electric Company, and doubly so to the person who was willing to invest his money in an enterprise when he was advised that the scheme was not feasible. He certainly deserves to be classed in the front rank of central station men in Canada.

Rev. Father Quay, of Gracefield, Que., has shipped five tons of amber colored mica to the United States, to be used for electrical purposes.

NOTES ON BELTING.

Tests of Leather, Rubber, Cotton and Other Belts.

By G. R. MACLEOD, MCGILL COLLEGE, MONTREAL.

FOR transmission of power by belting various materials are used. Among the most important are: Leather, rubber and cotton belts.

The material considered most favorable for belting is probably leather. It is very efficient and wears well, but is more expensive than rubber or cotton. In certain situations where it would be exposed to moisture, great heat, etc., its efficiency and durability are reduced.

Another weakness is that it must necessarily consist of short strips of about five feet in length, joined in various ways, which will be noticed later. The belt is therefore subject to failure in as many places as there are joints. Some methods, however, make the joints almost as strong as the solid leather, but the presence of the joint may cause the belt to fail, not from tension, but from a tendency to wear or crack at that point.

The best belts are made from oak-tanned ox-hide, the strongest part of the hide being the back. The belt can be made in long strips by taking a wide disc of leather and cutting it in a spiral direction. The strip thus cut is stretched taut and rubbed to make it straight. From a disc 4 ft. 9 in. wide a strip over 100 feet long of 2 inch belt can be made. If greater width is desired several strips can be sewn together side by side. A double belt of this kind has been used 75 inches wide and over 150 feet long.

The grain or hair side of the leather is put next the pulley. It would appear at first sight as if this were a mistake, since the grain side is the smoother and would therefore give less friction.

Mr. Arthur Archard, of Geneva, in a paper before the Institute of Mechanical Engineers, 1881, says:

"If the belt is wide, a partial vacuum is produced between the belt and the rim of the pulley, by the aid of an adequate velocity which causes the atmospheric pressure to press the belt close against the pulley; an adhesion is thereby produced which is totally independent of friction, and enables the tensions to be considerably reduced." This is very important, because the less the tension on the belt, the less will be the friction on bearings, and, hence, the greater power derived. A wide, thin belt is therefore better than a narrow, thick one, and this is so not only for the reason that it gives less tension on the belt, but because it also gives greater flexibility.

Mr. D. A. Low, in his *Machine Designing*, also states that the smooth side is the better "because it gives greater driving power," reasoning probably in the same way as Mr. Archard.

Mr. J. Tullis, of Glasgow, however, states that the belt will last longer if the grain side is out, and that coatings of curriers' dubbin and oil will make the flesh side as smooth as the other. All writers seem to agree that the adhesion of the belt to the pulley depends very little, if any, on friction, and that, therefore, a rough surface is more injurious than useful.

Rubber belting is superior to leather in damp places. The part of the belt that gives it strength is not the rubber, but the cotton framework.

It is made by taking a wide strip of cotton duck and folding it into as many plies as desired, with rubber in between, with a thicker coating of rubber on the outer side.

The rubber is in a liquid state when applied to the cotton, and when the belt is finished it consists of a strong, solid, flexible belt, having the appearance of solid rubber. There is almost no limit to the length that can be made in one piece, so that there is only one joint in any piece of belt in use. Even this can be avoided by ordering an endless belt for special cases. The manufactured product is usually very uniform in quality. Extremes of heat and cold have very little effect on it, and it has very little tendency to slip on the pulley. It should be kept free from all animal oils or grease, as these are injurious to the rubber. Rubber belting seems to be especially adapted for such purposes as elevators, for railways, pulp mills, mines, etc.

Cotton, that is cotton without rubber or any other material, makes an excellent belt. It can be made stronger than leather of the same cross-section, and of great length without joints. It is better than leather in moist places, and is less expensive. It was formerly made in the same way as cotton and rubber belting—that is, by laying one ply of cotton duck on top of another till the desired thickness was attained, and then sewing the whole together. The more modern method is to make the whole thickness together at one operation, each ply being interwoven with

the one next to it. The process of manufacture is rather complicated, but this does not make the belt expensive.

An improvement on the plain cotton belt is made by soaking it in a mixture of red lead and linseed oil. This process has the same effect as it has in preserving wood. The cotton belt is then more efficient in moist places or in conditions which are found very unfavorable to the use of leather or even rubber. Some modifications of this kind of belt are made by substituting for part of the cotton a woof of hair and other materials. An example of this is the "Camel Brand," tests of which are reported below.

Gutta percha has been used as a substitute for rubber, and has been found to be a good protection to the cotton. A special brand of this, called "Balata Belting," was tested. It is manufactured in England, and has a rather thick coating of gutta percha on the outer side, and thin layers between the layers of cotton, while the side next the pulley is coated with a solution called "Balata."

STRESSES IN BELTS.

Belts are subject to two kinds of stress, viz., tension and bending, but the most serious strain is caused by bending round the pulleys. If the pulleys are small, the only way is to use the most flexible material. This will probably be the cheapest in the long run.

A good rule is given by Lineham in his *Mechanical Engineering*, viz., the distance from centre to centre of pulleys should not be less than six times the diameter of the larger pulley.

A most important matter is that the edges of the belt should wear well. If the edge is not good it will soon become frayed by contact with the rim of the pulley, and will cause failure of the belt. The best edges that the writer has seen on any belt are on good oak tan leather, and on rubber. The structure of the latter (folding), together with a strong covering of rubber, secures a good, compact edge.

Belts of paper have been made and used in the United States with success. They are very strong and durable if not exposed to moisture, and they stretch very little while at work.

So far nothing has been said with regard to stretch of belts under tension. This will be treated along with the results of the tests.

Creep in belts is due to the belt stretching on the tight side. If the belt stretches easily this is very serious. For every foot of belt that goes on the driver less than a foot goes off and goes on to the follower. If the diameters of the pulleys were equal the driver would make a greater number of revolutions in unit time than the follower would. Hence, if there is much stretch in the belt there is a loss of speed. This loss amounts to 1 per cent. to 3 per cent., depending on the elasticity of the belt; since the tension on the belt is kept as low as possible to prevent too much friction on bearings of the pulleys, the belt that is least extensible at low tensions is the one which is most valuable in this respect.

JOINTS AND FASTENINGS.

Joints form the weak feature of belts, so far as tensile strength and wear are concerned, especially in the case of leather belting. They are of two kinds, (a) permanent, (b) temporary.

Permanent joints take many different forms. In leather belting the most common is the laced joint (Fig. 1.) A lap-joint splice is made and cemented together; then two or three rows of rawhide lacing is put in. The holes for the lacing are not punched, but two sharp cuts are made for each stitch. The cuts should lie diagonally so as to injure the longitudinal fibres as little as possible.

Copper riveting is used as a substitute for lacing, the belt being spliced, as before, and a number of rivets inserted (Fig. 2.) This joint shows a tendency to break across a row of rivets, and is only about two-thirds the strength of the solid belt.

Harris metal plate fastener (Fig. 3) consists of a slightly curved plate, same width as the belt, with a number of spikes. The belt is cut with square ends, and the spikes are driven first through one piece and then the other. As the plate is curved and the spikes are perpendicular to it, they take a good firm grip on the leather. The spikes are clinched after connection.

In Lagrelle's fastener (Fig. 4) the ends of the belt are cut square and bent up. Strips of steel or iron are run through the holes cut for the purpose, each strip having two eyes to hold pins. These pins run through strips at each end, and form a wide link. In fasteners such as this the strain is distributed over the width of the belt, and there is also not the same tendency of cut through in front of the holes as in many other kinds.

TEMPORARY FASTENINGS.

The fastener shown in the accompanying sketch (Fig. 5) consists of a curved strip of iron. The ends of the belt are cut square

and holes are made to receive the fastenings, which are inserted and hammered flat.

Laced Joints. There are many forms of laced joints. The simplest is shown in Fig. 6.

Fig. 7 is the same joint as Fig. 6, but double laced.

Fig. 8 is a double laced joint with only one strand in each hole.

In the joint shown in Fig. 9 the holes are staggered; there is only one strand in each hole, and the strands do not cross on each other.

These are the commonest forms. Fig. 6 has hardly enough lacing; Fig. 7 has twice as much lacing as Fig. 6, but concentrates all the stress on a single row of holes. Joints like Fig. 8 and Fig. 9 give about the greatest possible strength of lacing.

The holes for the lacing are usually round punched. Awl holes are not so good. D. A. Low, Machine Designing, says that the holes should be oval punched, and should have the long diameter parallel to the edges of the belt. And on the face next the pulley the lacing should be as nearly parallel to the edge as possible. It is also better if the lacing does not cross on itself.

Double belting, generally speaking, is not so good as single, since flexibility is what is required. It has been found, however, in certain cases, such as the belt for a return saw, that a double belt wears best, being better able to stand the alternate stretching and buckling.

RESULTS OF TESTS.

Tests of belting were made in McGill College testing laboratory in 1896-7 on the Emery testing machine. When pressure from the accumulator is admitted gradually the diagram curve of extensions is quite smooth and regular, but when the machine is fed rapidly

This specimen has a cement splice without lace or rivets. It failed at 3,300 pounds per square inch.

Fracture took place, not in joint, but immediately at its edge.

A solid piece of this belt stood 4,000 pounds per square inch.

An unlaced cemented joint is stronger than a laced one, but lacing is necessary where the belt is exposed to heat or moisture.

RUBBER BELTING.

The specimens tested were manufactured by a Canadian company.

The curve of extensions is almost a straight line with a slight tendency to turn upwards immediately before fracture. This straight line indicates that the extensions are about the same for each increment of load, and hence that the material is very uniform. Another fact that shows the uniformity of the material is that the fracture in each case was clear and straight across the belt. It was not a tear but a break.

The method of measuring the extensions is shown by Fig. 10. Two pencil lines are ruled square across the belt exactly thirty inches apart. A scale graduated to hundredths of an inch is clamped with one end at the lower mark.

A long steel pointer is clamped at the other mark. As the belt stretches this pointer moves along the scale, thus giving the amount of stretch, which can be read in hundredths.

Fig. 11 shows the method of holding the specimen. A piece of steel rod *a* is placed in the loop of the belt, to take up the pressure from the two rods *bb*, whose section is a semi-circle; *bb* are fitted into grooves and are free to move, so that the pressure from them is always directed towards the center of *a*. A separate piece of

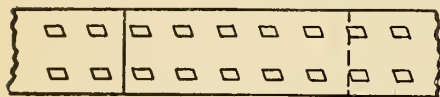


FIG. 1.



FIG. 2.

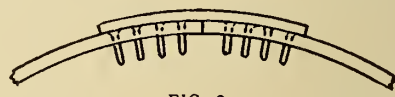


FIG. 3.



FIG. 4.



FIG. 5.



FIG. 6.



FIG. 7.

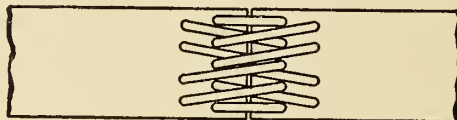


FIG. 8.



FIG. 9.

the extensions are less; this becomes more noticeable in belt testing. It shows as a sharp change in the curve, but when the feed is again better regulated the curve resumes its former course. In some cases these sharp changes in the curve may be due to lack of uniformity in the material, particularly in the case of belting composed of cotton and hair. Extensions were read at every 200 pounds increase of load, except in some of the larger specimens, where readings were taken every 500 pounds increase.

Leather Belting.—Specimens were procured from a dealer in Montreal.

NO. 1.—ENGLISH OAK TAN LEATHER.

Width, 2 in. Sectional area, .453 square in.

Weight, .213 lb. per lineal foot.

Cost, 23 cents per ft.

Total stretch in 24 in. was 2.15 in. = 9 per cent.

Permanent stretch, 0.2 per cent.

Maximum strength, 2,210 lbs. per square in.

This specimen contained a spliced cemented joint and laced in the same manner as first example described under "Joints." It broke straight across the middle of the joint.

NO. 2.—(Same belt as No. 1, but without joint.)

Maximum strength, 4,640 lbs. per square in.

This shows that the strength of the joint is about one-half the strength of the solid belt.

NO. 3.—HEMLOCK TAN LEATHER.

Width, 3½ in.

Sectional area, .798 square in.

Weight, .206 lbs. per ft.

Cost, 43 cents per ft.

Total extension was 3.11 in. in 18 in. = 18.3 per cent.

belting *c* is placed between the jaw and the specimen to protect the latter from being cut by the jaws. Four bolts *d* are used to tighten the jaws. When the belt stretches its thickness is diminished. The bolts are then tightened more to prevent slipping. The jaws are connected to the piston of the ram by a ball and socket joint. They can thus adjust themselves to any unevenness in tension.

SPECIMEN NO. 1.

Width, 4 in. Sectional area, .84 square in.

Weight, .4768 lb. per lineal ft.

Cost, 42 cents per ft.

Broke at 4,170 lbs. per square in.

Total extension in 30 in. = 3.00 in. = 10 per cent.

Permanent extension, 0.13 per cent.

SPECIMEN NO. 2.

Width, 5 in. Sectional area, 1.1 square in.

Weight, .635 lb. per lineal ft.

Cost, 52 cents per ft.

Broke at 4,270 lbs. per square in.

Total extension, 14.9 per cent.

Permanent stretch, 3.0 per cent.

SPECIMEN NO. 3.

Width, 6 in. Section, 1.505 square in.

Weight, .844 lb. per lineal ft.

Cost, 62 cents per ft.

Broke at 3,790 lbs. per square in.

Total stretch, 16.4 per cent.

Permanent stretch, 3.0 per cent.

SPECIMEN NO. 4.

Width, 8 in. Section, 1.92 square in.

Weight, 1.032 lbs. per ft.
Cost, 84 cents per ft.
Broke at 3,700 lbs. per square in.
Total stretch, 17.0 per cent.
Permanent stretch, 1.9 per cent.

SPECIMEN NO. 5.

Width, 10 in.

Weight, 1.1434 lbs. per lineal ft.

Cost, \$1.07 per ft.
Maximum load, 3,320 lbs. per square in.
Total stretch, 13.9 per cent.
Permanent stretch, 1.6 per cent.

SPECIMEN NO. 6.

Width, 12 in.

Weight, 1.2806 lbs. per lineal ft.

Cost, \$1.30 per ft.
Maximum load, 3,540 lbs. per square in.
Total extension, 14.5 per cent.
Permanent extension, 2.4 per cent.

SPECIMEN NO. 7.

Width, 14 in.

Weight, 1.812 lbs. per ft.

Cost, \$1.54 per ft.
Maximum load, 3,620 lbs. per square in.
Total extension, 15.8 per cent.
Permanent extension, 2.0 per cent.

CAMEL BELTING.

This belting is made partly of cotton and partly of coarse camel hair, said to be the combings of camels. The cotton is the material which forms the chief strength, and therefore the longitudinal fibres are cotton. The hair yarn forms a woof, although in some of the specimens tested there were strands of hair running longitudinally as well as transversely. The two materials being interwoven in several plies, the belt is soaked in red paint and allowed to dry. The paint forms



FIG. 10.

a good body coating, which protects the belt from moisture and makes it very durable. To prevent the belt from becoming stiff and hard an occasional coating of castor oil and tallow should be applied; but any resinous mixture is injurious. In making the lace holes a sharp awl should be used instead of a punch, as the latter cuts the threads and thus weakens the belt.

SPECIMEN NO. 1.

Sectional area, $4.35'' \times 29'' = 1.262$ square in.

Weight, .5717 lbs. per ft.

Cost, 33 cents per ft.

Total extension, 31.9 per cent.

Permanent extension, 11.6 per cent.

Maximum load, 5,960 lbs. per square inch.

SPECIMEN NO. 2.

Section, $5.07'' \times .24'' = 1.22$ square in.

Weight, .599 lb. per ft.

Cost, 39 cents per ft.

Total stretch, 35.1 per cent.

Permanent stretch, 4.45 per cent.

Maximum load, 5,570 lbs. per square in.

SPECIMEN NO. 3.

Section $6.1'' \times .28'' = 1.71$ square in.

Double or "Russian Brand."

Weight, .7995 lb. per ft.

Cost, \$1.00 per ft.

Total extension, 24.5 per cent.

Permanent extension, 7.1 per cent.

Maximum load, 5,900 lbs. per square in.

SPECIMEN NO. 4.

Section, $5.95'' \times .22'' = 1.31$ square in.

Weight, .599 lb. per ft.

Cost, 48 cents per ft.

Total stretch, 27.6 per cent.

Permanent stretch, 12.9 per cent.

Maximum load, 5,650 lbs. per square in.

SPECIMEN NO. 5.

Section, $6.1'' \times 30'' = 1.83$ square in.

Weight, .781 lb. per ft.

Cost, 58 cents per ft.

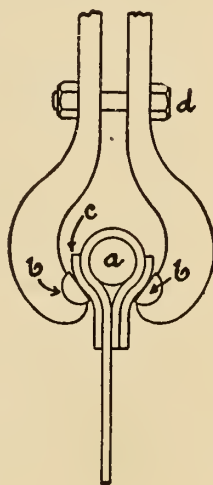


FIG. 11.

Total stretch, 20.6 per cent.

Maximum load, 5,360 lbs. per square in.

SPECIMEN NO. 6.

Section, $12.20'' \times .31'' = 3.78$ square in.

Weight, 1.705 lbs. per ft.

Cost, \$1.33 per ft.

Total stretch, 38.0 per cent.

Permanent stretch, 19.3 per cent.

Maximum load, 5,160 lbs. per square in.

A glance at the curves shows that for small loads the extensions are uniform and even have a tendency to decrease until a certain limit is reached. The elastic limit comes much sooner than in rubber and leather, and there is an enormous extension at the ultimate strength.

The ultimate strength is much greater than that of rubber and leather, etc., but the belt would never be used in such high tension.

PATENT "BALATA" BELTING.

This kind of belting already described seems to be very good. It is very strong, and the amount of stretch is small.

The gutta percha is said to bend over small pulleys with more ease than rubber, and it is also claimed it resists heat and moisture better. It has cheapness in its favor, and is likely to become a popular belt. Only one specimen was tested:

Section, $4.45'' \times .22'' = .979$ square in.

Weight, .433 lb. per ft.

Cost, 46 cents per ft.

Total stretch, 15.7 per cent.

Permanent stretch, 4.4 per cent.

Maximum load, 5,210 lbs. per square in.

Table showing comparative value of belts:

Kinds of Belts.	Ultimate strength.		Total Stretch.	Stretch at 400 Lbs. per Square Inch.	Permanent Set.
	Per Square In.	Per Lb. per Ft.			
Leather.	4,320	12,200	10.5 to 18.3%	1.0%	0.5%
Rubber.	3,773	7,295	14.6%	2.2%	2.05%
"Camel"	5,860	12,050	29.6%	2.25%	13.1%
"Balata"	5,210	11,750	15.7%	1.16%	4.4%

The column "Strength per lb. per ft.," gives a fair idea of the proportionate driving power that can be got out of the same weight of different kinds of belt.

The last two columns show the comparative values with regard to stretch.

PRICES.

Leather.....10 cents per ft. for 1" belt, to \$12.00 per ft. for 72"
Rubber.....21 cents per ft. for 2" belt, to \$6.72 per ft. for 52"
"Camel".....12 cents per ft. for 2" belt, to \$1.33 p r ft. for 12"
"Balata".....21 cents per ft. for 2" belt, to \$1.30 per ft. for 12"

The "Camel" belting is by far the strongest, but its stretch is greatest. Where it can be used, the leather is probably the most economical, although it is very expensive in large widths. It is the lightest, and less power is lost by stretch.

The gutta percha comes next for lightness and driving power, and would therefore seem to be the most serviceable belt of all. But it is hardly fair to come to such a conclusion when only one specimen was tested.

The Montreal Cotton Company, of Valleyfield, Que., in addition to the very large increase order placed in August, have given a further order to the Canadian General Electric Company for a 150 h.p. induction motor.

In France two methods of electric traction on canals have been tried. In the one, a special form of electric car is propelled along the towing-path, and is connected to the barge by a rope. In the other, a detachable screw propeller worked direct by an electric motor is used. The current in either case is supplied by an overhead conductor and trolley.

No boiler will give good results unless the circulation is free and rapid. To overcome the difficulty experienced with some kinds, where there is no circulation in some parts of them, ejectors have been used to take the water out of the dead spaces and discharge it into other parts where the water is always in motion so long as there is any fire in the furnace.

Loose crank pins, and how to make them tight, is an interesting theme, and frequently comes up for discussion among engineers. One of the best remedies that I have heard of is to bore holes partly in the pin and partly in the boss of the crank, the holes being parallel to the axis of the pin, then driving in iron bolts that are a perfect fit and rivetting them solidly in place.

IMPROVEMENTS IN THE ARC LAMP.

By ROBERT A. ROSS, E.E.

THE prominent place which the arc lamp took in the earlier years of electric lighting, involving as it did the designing and operation of the complicated series arc machine, has always excited comment, and the permanency of the types of apparatus then designed is astonishing. From the commercial beginning of arc lighting in the year 1879 up till the present, the direct current series lamp has undergone comparatively little change except in the smaller details. It is true that during the earlier years the questions of open and closed circuit types, of clock-work, clutch and rack-feeds were fiercely discussed, but the lamps which have stood the test of time and which are now considered good commercial articles are much as they were when originally designed.

During the first eleven years of its existence the series arc lamp stood alone, in spite of the fact that the need was apparent for other types which would operate on the constant potential lines of direct and alternating systems. The result of the attempts to develop these types has been to produce in 1890 the constant potential direct current arc lamp to operate two in series on the 110 volt incandescent service lines, to give us, about 1892, the alternating current constant potential type, and in 1894 the enclosed type of the direct current arc.

At the present time all of these types are in successful operation, and in addition during the past year the enclosed alternating lamp has attained a thoroughly commercial form. The development of the several arc lighting systems by series, parallel, direct, and alternating current distribution has depended upon the development of suitable lamps alone, and gave us the series direct current system first, because of the simplicity of operation of the series lamp. The reason of this simplicity of operation is not far to seek, if we remember that after the arc is struck the regulating mechanism performs but one function, namely, to regulate the arc voltage, the current regulation being done at the machine regulator. On the other hand, the lamp mechanism for operation between constant potential lines regulates the arc voltage as well as the current, and as a consequence there is going on at all times a struggle between the forces by which these two factors are governed. It is this chiefly which necessitates the placing of a resistance in series with these lamps to prevent pumping. This trouble is not so apparent in the alternating type with which a choke or economy coil is used, as in addition to the resistance of the coil the inductance is of effect to dam back excessive current rushes. Another feature which long held the lamp for parallel operation in the background was the fact that the art of carbon-making had not advanced sufficiently to admit of the commercial manufacture of the high grades necessary for its successful operation. On the other hand, the force which has been of greatest effect in developing the constant potential type was the necessity which existed for the use of arc lamps on the incandescent service lines and the consequent uniformity and simplicity of the line and station equipment. The advantages attendant upon the use of the constant potential lamp have at the present practically banished the series arc from the field of interior lighting, and in many new plants are leaving no place for it even in what has been considered its own peculiar field, that of street lighting.

The question whether the series arc will retain its supremacy for outside illumination will depend largely upon whether machines capable of being direct connected or at least belted direct to fair sized engines can be built and operated. There seems to be a fair prospect of this, if we are to judge by the results of the past four or five years, within which time the limit of size has passed from about sixty to three times that number of lamps per machine. It is evident, however, that the limitations of safety will prevent the grouping of any such large number as might be desirable for other reasons on a simple series loop, and will force the adoption of systems of return loops as in the Brush machine, where several circuits are run from the same machine, and the line to line potential on each circuit correspondingly reduced, or by some other series parallel grouping of circuits which will give the effect of keeping down excessive line voltages while admitting of the use of large units in the station.

The advantages which the series system possesses for the distribution and control of light over large areas when coupled with the equally evident advantage of the use of alternating current generators, which are the standard type for most stations, have long been recognized, and some fairly successful attempts have been made to use alternating current lamps on series alternating circuits taken either from the constant potential bus bars of the station which feed the incandescent service primaries, or from the same bus bars through a self regulating transformer, which gives a constant current through the lamps placed in series on the circuit. As to the operation of these circuits there appears to be no great difficulty, and were it not for the fact that the light distribution from the alternating lamp is poor, and the cost of the superior carbons, which are necessarily so high, there is no apparent reason why this system should not displace the direct current series system with its separate and special generating units, thus permitting the distribution of incandescent and arc lighting from the same generators and the separate control of the arc lights as on the direct current series system at present in

use. There appears to be a large field for this system in spite of the disadvantages mentioned above.

The development of the enclosed arc lamp has been a curious example of the effect of preconceived ideas in holding back much needed inventions. As early as 1846, Staite, recognizing the need for the enclosed arc with its long burning advantages, undertook its development, but without success, as were the efforts of others up till about 1894, when the lamp became a commercial success. The chief reason for the failures up to that time was that the endeavor had been to produce an arc similar to that in the open series lamp, which in the light of later knowledge was a mistake.

The open lamp has a normal arc of 45 volts, while the enclosed works to best advantage at about 80, the arc at the higher potential being much more stable and giving a better distribution of the light than at the lower voltage at which most of the experiments up till 1894 had been made. In addition to this misconception of the value of the long arc which enclosure made possible, the difficulty of obtaining enclosing globes which would withstand the heat, and the commercial impossibility of obtaining pure carbons which would not darken the globe, delayed seriously the appearance of the enclosed arc. These difficulties overcome, the increased voltage of the arc which in the series system is a disadvantage, were seen to be of decided advantage, as it enabled the lamp to be operated and controlled singly from the constant potential 110 volt lines from which the incandescent lighting was wired instead of two in series across the lines as the practice was with the open arc.

In comparing the relative advantages of open and enclosed arc lamps we find as follows :

1. That the enclosed type will burn for from 100 to 150 hours with one recarboning, as compared with 8 hours for single open lamps ; the cost of the carboning and trimming being reduced in proportion.
2. For operation on constant potential circuits the ability to operate one enclosed as compared with two open lamps across the mains is a very evident advantage.
3. No dust, sparks or hissing from the enclosed lamp.
4. Simpler mechanism, and better regulation due to the longer arc, and less flickering in the enclosed type, as it feeds but one-fifteenth to one-twentieth as often as the open arc.
5. As compared with the series circuit open arc, the enclosed constant potential lamp operates on a low and very safe voltage, and may be handled and operated precisely as an incandescent lamp, thus making it especially suitable for interior illumination.

These are all advantages on the side of the enclosed type, but against this we must balance the decreased light giving power per watt of consumption due to the use of the opaline or ground enclosing globes which are necessary for the proper diffusion of the light, and the loss of light due to the smutting of the globes with carbon dust, which becomes a serious matter after about 100 hours of running ; also there is the extra cleaning of the enclosing globe and the maintenance of same.

For interior illumination, however, where a ground globe is a necessity for proper diffusion in both cases, the open and closed types are on an equality so far as light giving efficiency is concerned.

It appears, therefore, that for all purposes of interior illumination and in many cases of outside lighting, the enclosed arc has decidedly the advantage, and the records in the larger cities of the United States show that these advantages have been recognized, and for most of the new installations of arc lamps the enclosed has been selected as the most suitable.

For the purpose of showing the different light giving efficiencies of the various types of lamps, as well as to place in accessible form the usual voltages and amperes in use in their respective arcs, the following table has been figured on the basis of 450 watts consumption at the arc in each case, that being the standard usually adopted. To complete the combinations all of the probable systems are considered, although several are not much used as yet, but the figures indicate what may be expected when they are adopted as the lamps are developed for all of them.

LIGHT GIVING EFFICIENCIES OF DIFFERENT ARC LIGHT SYSTEMS.

	Amperes		Volts in		Watts in		Candle power.		Watts per C.P.		C.P. per H.P.	
	Arc.	Line.	Arc.	Line.	Arc.	Line.	Outside.	Inside.	Outside.	Inside.	Outside.	Inside.
	1	2	3	4	5	6	7	8	9	10	11	
DIRECT CURRENT.												
Series Open.....	10	45	50	450	500	650	450	7	1.0	750	520	
Series Enclosed.....	6.5	70	75	450	500	375	450	1.2	1.0	440	520	
Constant Potential Open.....	10	45	55	450	550	650	450	7	1.0	750	520	
Constant Potential Enclosed..	5.6	80	104	450	580	375	450	1.2	1.0	440	520	
ALTERNATING CURRENT.												
Series Open.....	15	30	33	450	500	375	300	1.2	1.5	470	370	
Series Enclosed.....	6.5	70	75	450	500	225	300	2.0	1.5	285	370	
Constant Potential Open.....	15	30	33	450	500	375	300	1.2	1.5	470	370	
Constant Potential Enclosed..	6.5	70	75	450	500	225	300	2.0	1.5	285	370	

Columns 1 and 2 give the volts and amperes at the arc ; column 3 the voltage in the line or at the terminals of the transforming device,

which is necessary for their commercial operation. Column 5 gives the consumption in watts at the terminals of the lamp. Column 6 gives the mean illumination of horizontal surfaces or the useful illumination from the lower hemisphere of the lamp, allowing for the absorption of light of 10% in the clear globe of the open lamp, and 40% in the opaline globes which are necessary for the enclosed type. If opaline or ground globes be used for all types as should be done in the illumination of interiors, the useful candle power is given in column 7, in which due allowance has been made for the effect of the upper hemisphere of light, of which it has been considered that 50% of that passing above the horizontal lines is reflected from walls and ceilings and becomes useful. These figures have been obtained from a consideration of a number of tests which vary widely, and can be considered as being as nearly as possible an approximation to average conditions. Columns 8 and 9 give the average watts at the arc per useful candle power figured from columns 6, 7 and 4, and indicate the probable consumption of energy in the arc per useful candle power for inside, and for outside lighting with the several systems. Columns 10 and 11 are figured from columns 8 and 9 and indicate the useful candle powers which may be expected per belt horse power in the station, allowing for fair average commercial efficiencies of generators, lines, transformers, choke coils, etc. The figures in column 10 indicate that for out-door illumination, where clear globes are used on the open lamps, and opaline on the enclosed type, to give a proper distribution the useful light giving efficiency of the direct current enclosed type is 60 per cent., of the alternating current open type 70 per cent., and of the alternating current enclosed type 40 per cent., of the direct current series arc per unit of energy in the station at the dynamo pulley. Column 11 indicates that for interior illumination where opaline globes are used on all types to get proper dispersion, the direct current lamps on all systems are on a par, and the alternating lamp efficiency in all cases about 70 per cent. of the direct. In considering these results it must be remembered that the series machine is much less efficient than the constant potential machine, which makes up for the smaller efficiency of the lamps on that system, and that the alternating arcs have a large light giving area above the horizontal which is considered as partially useful in columns 7 and 11 for inside lighting, but is considered as wasted for out-door illumination in columns 6 and 10. The direct current type, owing to the shape of the positive carbon, throws its light mainly downwards, and the upper hemisphere of light plays little part in interior illumination.

From the above considerations it appears that for outside illumination the series open arc will hold its own where the question of the simplification of the plant by doing away with the arc machines is not given first place. For interior lighting on the other hand, the enclosed direct current, or the alternating lamp of either open or closed types, will certainly displace the series arc, and will broaden that field largely and displace many incandescent lamps in large interiors. For this purpose arc lamps of small candle powers which are now offering will find a place. It must be remembered, however, that the candle power per watt of consumption for these smaller lamps decreases quite rapidly as the current consumption is lowered.

SPECIMEN OF MUNICIPAL TACTICS.

To the Editor of the CANADIAN ELECTRICAL NEWS:

SIR,—Knowing that you are a great admirer of nerve, I send you the enclosed, received from the clerk of the Water and Light Department of a city in the maritime province where there is apparently a municipal plant. For a concentrated essence of the above commodity this breaks the record. It is not enough that the municipalities want to confiscate our business without compensation, but expect us to find them with brains enough to run the thing to boot.

If the town has not a man in its employ who knows enough to give this information, it ought to have, and should get one right away. If they cannot afford to pay for one (which seems likely), they have no right to be in the business at all. Such information can only be had by years of costly experience, and is worth money. If the municipality is determined to have such a luxury as a civic electric plant, they should be willing to pay the piper for the music they want to dance to.

Yours truly,

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[COPY.]

CITY OF MONCTON, N. B.,
Water and Light Department, OCTOBER 20, 1898.

TO THE MANAGER

DEAR SIR,—We have been considering the advisability of making some changes in our electric light plant, and wish to get the opinion of competent men on the following points:

Which do you consider, high or slow speed engines, the most economical for steam plant? What are you using in your station? Name maker and style of engine used.

What is your average consumption of coal per horse power hour? What is your consumption of oil in proportion to horse power?

What do you consider the best and most modern arc dynamo on the market? Also the best incandescent alternating dynamo?

What do you figure the net cost per incandescent lamp per night (all night)? Also to 12 o'clock?

What type transformer do you consider the best?

What type of transformer do you use?

What does your coal cost? What kind do you use?

What does your oil cost per gallon—cylinder, engine and dynamo?

What do you charge per incandescent light per night?

What are your meter rates per 1,000 watts?

What do you charge per commercial arc light per night?

What do you charge per street arc light per night?

We are at present supplying about 1,000 incandescent lights, 53 street arc lights, and 40 commercial arc lights.

Average run summer months 10 hours, winter 16 hours.

Our incandescent circuit is about 10 miles, our arc circuit about 14 miles.

We would like your opinion as to the number of men required, including electrician, to operate a plant of this capacity. The latter question would not include our engineer and manager, or accountant.

You will understand that we have the water and gas as well under our management.

The above staff to make all extensions to circuits, all repairs, installations, etc.

We would thank you if you can answer the above at an early date; trusting it may come in our way some day to return the compliment.

Yours sincerely,

CITY OF MONCTON,

Per M. L.

ENGINEERING NOTES.

INSPECTING BELT LACING.—A good practice is to draw in extra pieces of lacing over the regular strips, and then have a board in close proximity to the belt as it runs. The result is that the outside pieces, which are not intended to hold any of the stress, catch all of the wear, and as soon as a piece is worn in two the centrifugal force due to its motion causes it to strike the board and attract attention. It is not at all necessary to shut down when this warning note is heard, for no one will know it to be but the outer part, but it should be attended to the next time that the engine is shut down. The adoption of this plan will save delays in many places where they are now considered a necessary evil.

OLIVE OIL.—There is no question but olive is the best oil to be used for many purposes in both mill and shop; its advantages over other kinds are that it softens, and even after a year or more does not become stiff and hard, and the oil remains fresh and sweet in it. It is very difficult to detect adulteration in oil, and as olive oil is mixed to a large extent with cotton seed oil, it behooves the purchaser to be very careful what he is doing, or some smart "drummer" will sell him a few barrels of cottonseed oil with a little olive mixed in for the best pure olive oil. The following is a good test for oil: Take a portion of the oil and stir it up with forty parts of a solution of carbonate of soda of three degrees of Baume. If the oil forms a milky emulsion, without any oil drops on the surface, it is a guarantee for a good greasing of the object to which it is applied.

BOILER CLEANERS.—A correspondent of the Scientific Machinist, on the advice of a brother engineer, took a good sized stick of cordwood (oak), put it in the boiler and screwed it to the brace so that it could not get fast between the flue and the shell when the water was low. After a week's run he found a great deal of scale had come off the sides, and a lot more was loose that was easily knocked off. At the end of the third week the scale was loose on the flues and easily knocked off. By continuing to use oak wood and to clean out once a week, in a remarkably short time he had the boiler free from scale. The difference in firing alone was no small matter. It is best, he says, to clean every week when using the wood, as it does not reduce the scale to a mud. Blowing off causes it to gather around the blow-off, which, if left too long, is apt to burn the shell, owing to its keeping the water from the shell.

BUSINESS IS BUSINESS.

"The man who whispers down a well
About the goods he has to sell,
Won't reap the gleaming golden dollars
Like one who climbs a tree and hollers."

W. Miller, of Glen Miller, Ont., is installing a new electric plant for his paper mills, and has purchased a 150 light machine from the Canadian General Electric Company.

The Robb Engineering Co., of Amherst, N.S., have established an agency at Winnipeg, Man. Their representative, Mr. John Carroll, recently made a trip through British Columbia and the west.

SPARKS.

Madill Bros., of Lakefield, are offering their electric plant for sale.

The city of Victoria, B.C., will likely appoint an inspector of electric wiring.

During the coming winter the Ottawa Electric Railway Company will build a large number of open street cars.

The directors of the St. Thomas Street Railway Company are considering the extension of their road to Port Stanley.

The town of Owen Sound, Ont., invites tenders up to 15th inst. for the construction of a fire alarm telegraph system.

Negotiations are under way for the construction of a telephone line from Hickson to Tavistock, Ont., a distance of six miles.

Messrs. Munderloh & Co., of Montreal, recently ordered from the Canadian General Electric Company a 6 kilowatt incandescent dynamo.

Messrs. Barber Bros., of Georgetown, recently ordered from the Canadian General Electric Company a six kilowatt 500 volt motor.

Some of the citizens of Ste. Genevieve and Point Claire, Que., are considering the advisability of constructing an electric railway connecting the two places.

Mr. Roderick J. Parke, E.E., of Toronto, is preparing an estimate of the cost of installing a municipal electric light plant for the town of Pembroke, Ont.

A by-law to provide the sum of \$6,000 by the issue of debentures for the purchase of an electric light plant has been sanctioned by the ratepayers of Acton, Ont.

Messrs. Geo. White & Sons Co., Limited, of London, Ont., are at present engaged in erecting a new boiler shop, 70 x 70 feet, to meet the increased demands of their business.

The corporation of the city of New Westminster have ordered from the Canadian General Electric Company a 100 light incandescent dynamo and a six h.p. 500 volt motor.

The London Electric Company have just placed an order with the Canadian General Electric Company for two of their standard No. 12 125 light multi-circuit Brush arc dynamos.

James Richardson & Son have ordered from the Electrical Construction Company of London, Limited, a forty horse power multipolar motor, to operate G. T. R. elevator No. 2.

Mr. J. H. Head, of Hagarsville, Ont., has recently ordered from the Canadian General Electric Company a very compact lighting plant. The generator will have a capacity of 50 lights.

The Bells Asbestos Company, of Thedford Mines, P. Q., have ordered from the Canadian General Electric Company a 100 light dynamo, to be installed at their premises, Thedford Mines.

The British Columbia Sugar Refinery Company, of Vancouver, have recently ordered from the Canadian General Electric Company a 25 kilowatt generator of the well-known multipolar type.

The Peterboro and Ashburnham street railway was sold recently to Mr. Arthur Stevenson, for \$20,000. It is understood that Mr. Stevenson acted for some of the stockholders of the existing company.

The provincial asylum at Fairville, N.B., have placed an order with the Canadian General Electric Company for a six kilowatt motor and one 8½ kilowatt motor, of the well-known Edison bipolar type.

Messrs. Krug Brothers, of Chesley, Ont., have recently given an order to the Electrical Construction Co. of London, Limited, for a lighting plant, including a 150 light multipolar dynamo for incandescent lighting.

Mr. W. J. Camp, electrician for the C. P. R., is at present in Winnipeg, supervising the installation of the plant in the new offices of the company in that city. This plant, when completed, will be modern in every respect.

Mr. John Galt, C.E. and M.E., of Toronto, is designing an electric light plant for the town of Prescott, Ont. Commissioners will be appointed at the forthcoming January elections to arrange for the installation of the plant.

The Dundas Electric Company, Limited, of Dundas, Ont., have obtained a provincial charter, to supply light and power. The capital is \$40,000, and among the promoters are Messrs. John Bertram, G. H. Harper and E. B. Harper, all of Dundas.

The Fire, Water and Light Committee of the city council of Winnipeg, Man., are considering the question of submitting a by-law to the ratepayers to provide funds for the purchase of an electric light plant for lighting the streets and municipal buildings.

The directors of the Victoria Industrial School, Minico, Ont., have decided to install an electric plant for the lighting of the various buildings, and to carry out this work have purchased a 300 light plant from the Canadian General Electric Company.

The Iron Mask Gold Mining Co., of Rossland, B.C., have decided to operate their hoisting, drilling and carrying apparatus by electricity, and for this purpose have placed with the Royal Electric Company at Montreal, an order for 100 k.w. S.K.C. synchronous motor.

The Linde British Refrigeration Company, of Montreal, have recently ordered from the Canadian General Electric Company a 15 h.p. three phase induction motor. The power will be supplied to this induction motor from the circuits of the Lachine Rapids Hydraulic and Land Company.

Montreal shippers have complained to the Department of Agriculture at Ottawa respecting damage occasioned to perishable articles of export, owing to lack of proper ventilation on some of

the steamships. It is understood that about fifteen of the ocean-going steamers sailing from Montreal will be fitted this fall with electric apparatus for ventilation.

The employees of electrical companies in Toronto have organized a union, under the name of the Brotherhood of Electric Workers of Canada, in affiliation with the Trades and Labor Council. Mr. Thomas Eaton is president and Mr. F. Marson secretary.

Messrs. Wm. Jensen and Lawrence Goodacre, of Victoria, B.C., are endeavoring to form the Hardy Bay Tramway Company, Limited, to build a tramway from Hardy Bay to Coal Bay, Quatsino Sound. Should the scheme be carried out it is probable that electricity will be the motive power.

The City Council of St. Thomas, Ont., has instructed Mr. James A. Bell, city engineer, to make an estimate of the cost of a civic lighting plant of 100 arc lights for street purposes, and 3,000 incandescent lights for commercial purposes, the plant to be erected separate from the water works.

The War Eagle Consolidated Gold Mining Company, of Rossland, B.C., have ordered from the Canadian General Electric Company two 2 h.p. induction motors and one 10 h.p. induction motor. The power to operate these induction motors is to be furnished by the West Kootenay Power & Light Company.

The Stouffville Electric Light Co., of Stouffville, Ont., are making changes in their electric lighting station, among them being a new dynamo, with a capacity of about 500 lights. They are putting in an S.K.C. two phase machine from the works of the Royal Electric Company, so that they can supply power as well as light.

The People's Electric Company, of Windsor, Ont., owing to the very large and satisfactory increase in their lighting business, have recently placed an order with the Canadian General Electric Company to supply them with one of their 2,000 light iron-clad ventilated armature type single phase alternators.

The town of Campbellton, N.B., are installing a civic electric lighting plant. They are putting in Robb-Armstrong high-speed engines, with Monarch boilers, and one 60 kilowatt S.K.C. two phase dynamo, with the full capacity of the machine in transformers. They intend to use this S.K.C. machine for the supplying of arc lamps for the streets and incandescent lights for interior lighting, as well as for power in the daytime.

Mr. H. D. Symmes, of St. Catharines, has secured the contract from the corporation of Merriton for the lighting of their streets with 20 arc lamps. Mr. Symmes has also decided to undertake the operation of a commercial lighting plant, and for his requirements for this purpose has purchased from the Canadian General Electric Company one of their 1000 light, standard single-phase alternators. He proposes operating a street lighting service from the alternating system, using 2,000 c.p. enclosed alternating arc lamps. These lamps he has also purchased from the Canadian General Electric Company.

The British Columbia Gazette announces the incorporation of the Rossland Air Supply Company, with a capital of \$200,000, the object being to develop water powers under what is known as the Taylor hydraulic system of air compression. The company will first develop its power on Beaver Creek, it being proposed to transmit 2,000 horse power to the Le Roi mine, a distance of ten miles. The initial pressure will be 135 pounds, and the air will be transmitted through a 14" wrought iron pipe. The cost of the plant is estimated at \$150,000. Mr. A. J. McMillan, of Rossland, and Mr. D. J. Fitzgerald, of Trail, B.C., are interested.

An important change has been made in the course of lectures on "Steam and the Steam Engine" at the Toronto Technical School. This consists of dividing the subject into two parts, so that as well as the lectures on "the theory of heat engines or thermodynamics" others will be given of a practical nature, dealing with "the indicator, valves and valve motions, efficiency of engines and boilers, gas engines, etc." Mr. Harris P. Elliott, B.A.S.C., who has charge of this course, has had considerable experience in the actual design and construction of engines, and it is hoped that in this way it can be made interesting to mechanics and others who are not qualified to take the theoretical work.

Steam users throughout Canada and the United States now recognize the fact that the steam boiler is the source of energy of their factory, and its proper care is their aim. Not only do they give attention to external fixtures, but thoroughly investigate the interior, as experience has shown that corrosion, pitting and scaling cause expensive repairs, large fuel bills, and sometimes loss of life and property. It is not surprising, therefore, that the Wm. Sutton Compound Co., of Toronto, report many enquiries for their boiler compound. They state that they have been compelled to increase their staff and plant on different occasions, and that the compound is meeting with success from the Atlantic to the Pacific. It is a reliable preventive for scale and corrosion, and is claimed to be the only pure vegetable compound free from acid, caustic soda or zinc.

The Lunenburg Gas Co., of Lunenburg, N.S., are changing their electrical plant from steam to water power. They have a sixteen foot dam nearly completed on the Mush-Mush river at Mahone, eight miles from Lunenburg. This river, though small, has over ten square miles. These the company control, and can thus regulate the flow of the river as their needs may require. The Canadian General Electric Company are supplying the wire, transformers, switchboard and a 100 k.w. three phase generator. The pole line is completed, and is said to be the finest in that part of Nova Scotia. The water wheel is from the works of the S. Morgan Smith Co., York, Pa., and is one of their well-known "New Success" turbines. The company will light the village of Mahone, in addition to supplying light and power in Lunenburg.

SPARKS.

An electric light plant has been installed in Fould & Shaw's flour mill at Thorold, Ont.

Some of the ratepayers of Bradford, Ont., are in favor of taking steps to secure electric lighting.

The Hamilton Radial Railway Company* have let contracts for the extension of their road to Port Nelson.

The directors of the Hull Electric Railway Co. are considering the extension of their road to Gatineau Point.

The town of Bothwell, Ont., will vote on a by-law to raise the sum of \$4,000 to install an electric light plant.

The Cornwall Electric Street Railway Company are said to contemplate considerable improvements to their system.

The Citizens Electric Light Co., of Smith's Falls, Ont., have added to their equipment a new dynamo of 1500 lights capacity.

The Goldie & McCulloch Co., of Galt, Ont., are supplying three large boilers for the C.P.R. elevator at St. John, N.B.

The Bell Telephone Company are fitting up a new exchange at Perth, Ont., under the direction of the district superintendent, Mr. Gilmour.

A proposal to expend the sum of \$5,000 in improving the electric light plant was voted down by the ratepayers of Mitchell, Ont., on October 18th.

The town council of Thorold, Ont., has postponed until January next the submission of a by-law to provide \$7,000 for the extension of the electric light plant.

O'Riley & Murphy, of Ottawa, have put in the necessary fittings and wiring for lighting the Rideau street convent in that city. In all, about 150 incandescent lights are wired up.

The Bell Telephone Company have been given a renewal of their telephone franchise in the city of St. Thomas, Ont., having reduced the price of telephones in residences to \$20 per year.

Jas. Parcell, second engineer of the steamer Chicora, plying between Toronto and Niagara, was presented with a handsome cruet stand by the mechanical and engineering staff on the last trip of the steamer for this season.

Mr. John Shields, well-known in Eastern Canada, has recently completed the installation of electric lighting and waterworks plants at Ashcroft, B.C. The plants are said to be among the most complete in the province.

The Dominion Public Works Department reports that excellent progress is being made in deep water telegraphs. A line has been laid along the north shore of the St. Lawrence, and the cable will soon be completed to Belle Isle.

The Lake Ontario Navigation Company are building a new steamer, to be equipped with an electric light plant, the contract for which has not yet been awarded. Mr. A. W. Hepburn, of Picton, Ont., is the principal member of the company.

The Montreal Street Railway Company discovered that car tickets were being stolen by certain conductors, and have taken steps to punish the offenders. The method of the conductors was to pull the tickets out of the box, either by means of the finger or a small wire.

The village of Grenville, Que., offers a good opening for the installation of an electric plant for lighting the village and both sides of the river, as well as the canals. There is an almost unlimited water power, and favorable terms could, it is thought, be made with the municipality.

A. G. Best, agent for the Massey-Harris Company at Cobden, Ont., was injured in an acetylene gas explosion recently. Mr. Best was installing a generator, when he held a lighted candle near the carbide chamber, thus causing the explosion. His injuries are not regarded as serious.

The town council of Orillia, Ont., at a recent meeting, discussed the question of engaging a consulting electrical engineer. The Fire and Light Committee recommended the engagement of Mr. Roderick J. Parke, of Toronto, which recommendation was finally concurred in by the council.

The telegraph operators employed on the Canada Atlantic Railway waited upon Mr. J. R. Booth and presented a demand for shorter hours and higher wages. The men work 12 hours a day, and receive an average salary of about \$35 per month. As yet their demands have not been complied with.

The Canadian General Electric Company have just received an order from William Cook, of St. Catharines, for one of their standard 60 kilowatt single phase alternators. It is Mr. Cook's intention to undertake the furnishing of light to private consumers in connection with his present power plant.

A special committee was recently appointed by the city council of Halifax, N.S., to report as to the advisability of the city undertaking its own street lighting. As a result thereof, the city engineer and electrician have been instructed to prepare plans and specifications, and invite tenders for an electric light plant.

A proposal is under consideration to build an electric railway from Rondeau Park to Thamesville, via Ridgetown, Selton and Morpeth. At a recent meeting held at Ridgetown, at which Mr. Robert Ferguson, M.P.P., was president, and Mr. W. E. Gundy secretary, it was decided to form a directorate and apply for a charter.

The Dominion government is asking for tenders up to November 21st for the erection of a power house and the installation therein of the necessary electrical apparatus for operating the locks, bridges, etc., and for lighting the Soulages Canal. Plans may be seen at the office of the Chief Engineer of the Department of Railways and Canals, Ottawa.

Justice Walkem has given judgment for the plaintiff in the case of Arthur vs. the city of Nelson, a motion to quash the electric light by-law authorizing the council of Nelson, B.C., to borrow money to purchase an electric light plant from a private company. Mayor Houston was a director of the company, and on that ground the by-law was quashed.

The Metis Telephone Company, at a meeting held at St. Octave de Metis, Que., elected the following officers: Honorary president, Dr. J.

A. Ross, M.P.; honorary vice-president, Mr. L. F. Pinault, M.P.; directors, Rev. Mr. Chouinard and Messrs. L. M. Desrosiers, Jule Gendron, A. C. Landry, L. M. Langlais, Dr. J. C. Demers and Donati Caron.

The St. Malo, Que., municipal council has granted the Jacques Cartier Water Power Co. exemption from taxation for 15 years, on condition that they furnish electric light gratis to the municipality.

The Rogers Electric Co., of London, Ont., have removed their head office to Toronto, but will retain a branch in London. They purpose giving close attention to the electrical supply trade.

Arrangements are in progress for the construction of a local telephone line from Cannington to Hartley, Victoria road, Kirkfield and other points. The line will give a circuit of about 60 miles.

Early in October the annual meeting of the Exeter Electric Light Co. was held at Exeter, Ont., at which a dividend of 5 per cent. was declared. Since the meeting the plant has been sold to Messrs. Snell & Tremaine.

S. Paquette was instantly killed in Montreal by coming in contact with a live wire. He was swinging a derrick when it touched the wire, the insulation of which was worn off, and a current of 2000 volts came down the derrick wire rope and killed him.

Mr. J. A. Jamieson, superintendent C.P.R. elevators, St. John, N.B., has given an order to the Canadian General Electric Company for one 30 kilowatt generator of their well-known type, together with all the wiring material required to complete the installation.

Mr. Jas. Patterson, engineer for the Hamilton, Grimsby & Beamsville Electric Railway Company, estimates the cost of extending the road from Beamsville to St. Catharines at \$107,000, there being a grade of 3 per cent. It is improbable that the extension will be carried out.

The annual meeting of the Merchants' Telephone Company was held in Montreal early in October. It was decided to increase the capital stock by \$100,000. Officers were elected as follows: President, A. S. Hamelin; vice-president, J. E. Beaudoin; treasurer, L. E. Beauchamp; directors, A. S. Delisle, L. H. Henault, S. L'Archeveque, J. B. Thibodeau, J.-N. Ducharme and R. Beauchamp.

A special meeting of the shareholders of the Royal Electric Co. took place in Montreal on October 18th, to consider the proposed issue of \$500,000 of preferred stock and the proposal for the Royal Electric Co. to increase its holdings in the Chambly Mfg. Co. from \$200,000 to \$300,000. The shareholders voted against the issue of preferred stock, but the increased holding in the Chambly Mfg. Co. was carried unanimously.

The corporation of the town of Campbellford, Ont., has recently passed a by-law for the purpose of remodeling and increasing their electric plant, and to carry out the work have purchased from the Canadian General Electric Company one of their standard 120 kilowatt single phase alternators complete, together with the necessary transformers and wiring material. It is expected that, when completed, this will be one of the most modern plants in Canada.

A rumor was current in Toronto a fortnight ago that a scheme was under consideration for the consolidation of all the street railway systems in Canada. It is learned, however, that there were no grounds for the report, which evidently originated from the fact that a number of well-known capitalists interested in street railway ventures convened in Toronto on the 20th inst. It is now stated that a scheme for the extension of radial railways from Toronto throughout the province was under consideration.

A meeting of the shareholders of the Grand Falls Water Power and Boom Company was held at Fredericton, N.B., on October 21st. It was reported that the capital stock of the company, which is \$1,000,000, had been subscribed. Plans of the proposed works have been approved of by the Governor General-in-council, and operations are to be commenced forthwith. Hon. R. A. Alger, Sir William Van Horne, R. B. Angus, Hon. Rodden Proctor, William Mackenzie and Hugh McLean were elected directors.

Messrs. Howes & Leighton, of Harriston, Ont., have decided to comply with the request of the merchants of that place to provide incandescent lighting for commercial and residential purposes, as well as arc lighting, which they are now furnishing, and for this purpose have placed an order with the Canadian General Electric Company for one of their new type 30 kilowatt single phase alternators, with marble panels, instruments and all the transformers and wiring required for the installation.

The Ontario government will likely ask the courts to determine whether or not the Niagara Power Company has forfeited the charter which it obtained from the provincial authorities. The agreement between the government and the company called for the development of 10,000 horse power by the 1st November last, and of 25,000 horse power by a later period. The government takes the view that the company has not fulfilled the first of these conditions, and that it has therefore no further right to the charter. The company, on the other hand, points out that under another section of the agreement the charter was only to be forfeited in the event of a failure to transmit electricity. It claims that it has been impossible to comply with the latter condition, as up to a very recent period the problem of long distance transmission had not been solved. Furthermore, the company says it cannot fulfill the contract to supply electrical energy because there is no demand for it.

BANQUET OF STATIONARY ENGINEERS.

The Toronto branch of the Canadian Association of Stationary Engineers will hold their annual banquet on Thanksgiving eve, November 23rd. The event will take place at the Walker House, where the accommodation will be of the best, and an evening of profit and social re-union is assured. The dinner committee is as follows: John Marr, chairman; Chas. Moseley, Wm. Tait, Geo. Thomson, Geo. Mooring, John Bain, John Bannan.

ELECTRIC RAILWAY DEPARTMENT.

THE ST. THOMAS STREET RAILWAY.

THE St. Thomas street railway, which for so many years gave to the city the name of the horse-car town, has passed away, and in its place a real live, up-to-date electric street railway service is in full blast. The work of constructing the new road was undertaken by local capitalists entirely, with one exception, and June 15th, 1898, saw the road complete and in full operation.

Mr. Chas. McBeth, a graduate of the School of Practical Science, was engaged as electrical engineer, and is said to have handled the work with the assurance of a veteran. Mr. McBeth superintended the electrical equipment, while Mr. Thos. Kerr, of the London Street Railway, gave him valuable assistance with the track laying. The work of laying the track was proceeded with rapidly, no trouble between the city and the railway company arising to hinder the work, as is too often the case.

The company, instead of building a power house for themselves, engaged room in the spacious power house of the Gas & Electric Light Company, and purchased two 150 h.p. generators from the Canadian General Electric Company, and two engines from the Robb Engineering Company, of Amherst, Nova Scotia, the manager of the Gas & Electric Light Company looking after the working of them, and the railway paying for the power generated. The road is equipped with eight motor cars and two trailers of the most improved type, supplied by the Ottawa Car Company, the trucks being obtained from the Canada Switch & Spring Company, of Montreal. The cars are equipped with Canadian General equipment, 25 h.p. motors and double controllers. The cars at present in use have been found insufficient, and next spring it is the intention of the directors to place several more on the road.

The length of track is seven miles, five miles of a belt and two branch lines, one to the stations of the L. E. & D. R. and Grand Trunk Railways, and the other to the company's park, which is one of the features of the road. The park comprises about 100 acres, and is partly wooded by a beautiful bush. It is situated on the banks of Lake Pinafore, a very picturesque spot. Baseball, golf, cricket, lawn tennis, and bowling clubs are accommodated there with suitable grounds, bathing, boating and fishing appliances being furnished for these pastimes. Buildings are being erected for the accommodation of pic-nic and dancing parties. The directors are sparing no pains to make this one of the most beautiful parks in western Ontario, the natural facilities of the location assisting them very materially. This park is a boon to the city, being just what has been required for a number of years, and the electric railway has made it easy of access.

Mr. J. H. Still is president, and Col. Stacey, who held the horse car franchise, secretary-treasurer of the company. Mr. A. Bingham, who for fourteen years was local manager for the Bell Telephone Company in some of their largest exchanges, gave up that position and assumed the management of the street railway, preferring a larger field than the telephone offered for his labors. The road has every prospect of being a success financially, and should the company

decide to go to Port Stanley with an extension of their line, which is a possibility, there is no question but that the road will prove a bonanza to the shareholders.

LONDON STREET RAILWAY STRIKE.

As we go to press, a strike of the employees of the London, Ont., Street Railway Company is assuming a serious aspect, and much speculation is rife as to the outcome of same. On October 24th the men formed a division of the Street Railway Employees' Union, and submitted to the management of the road a petition asking for an increase in wages and a more regular division of work. They also asked that only union men be employed. A committee waited upon Mr. C. E. A. Carr, the manager, but he refused to recognize the union. It was then decided to inaugurate a strike, which was done, and since that time several unsuccessful attempts have been made by parties concerned to effect a settlement.

The company has offered to increase the scale of wages, but the men insist that the union shall be recognized. The strikers have, in some instances, resorted to despicable tactics in their efforts to accomplish their purposes, and for the past week no attempt has been made to run the cars. The company has refused a proposal made by the men to refer the matter to the arbitration of the Mayor, Judge William Elliott and Crown Attorney Magee, and thus negotiations with the men would seem to be at an end. The conditions under which the street railway franchise in London was granted provide that the company must employ residents of the city exclusively. This provision, to which the company should never have agreed, has greatly assisted the strikers, as in bringing in outside workmen the company are in danger of losing their franchise.

SPARKS.

The Yarmouth electric railway will probably be extended to Port Maitland next spring, says the Yarmouth News.

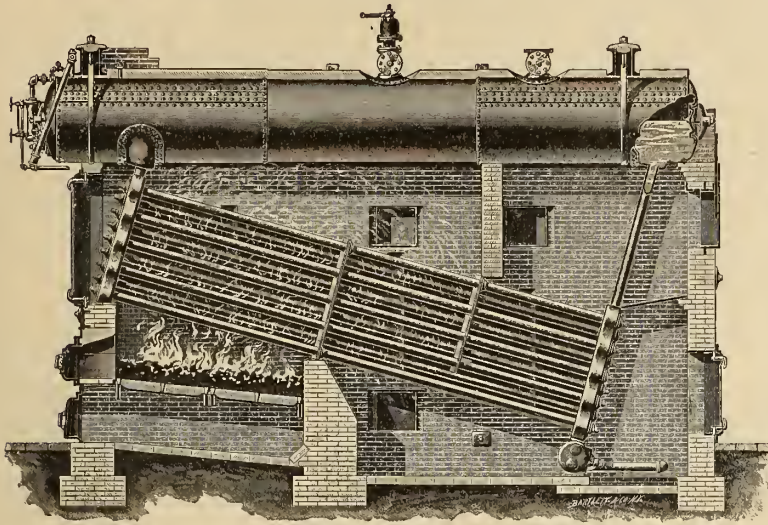
It is believed that the Ottawa Electric Company still have in view the extension of their line to Britannia. No steps will be taken, however, before next spring.

Mr. J. W. Leonard, general superintendent of the Ontario and Quebec division of the Canadian Pacific Railway, has been appointed a director of the Galt, Preston and Hespeler Street Railway Company.

The strained relations between the Weston village council and the Toronto City & Suburban Railway are at an end, an agreement satisfactory to both parties having been reached. By the agreement the railway company get back their franchise, and in return will extend their line 1,200 feet from its present terminus.

On October 31st the Ottawa Electric Railway Company made a test of a new fender on one of their cars. It is manufactured by the Consolidated Car Fender Co., of Providence, R.I., and is composed of two distinct parts, a cradle and a cushion. A steel bar projecting to the rear, under the platform, holds the cradle at any desired height. By means of a latch or trigger to be pressed by the foot of the motorman, the cradle is released so that its front edge drops to the ground, making it impossible for anything to get under the car. The cushion is a Resilient shield made of carefully tempered steel bands. This covers the iron bumpers and all other projecting parts of the platform, so as to effectually cushion the plough in case of a person being struck by a fast moving car. The Ottawa Car Company have taken the agency for Canada, and will manufacture the fender in Ottawa. The railway company will, it is said, apply this fender to 50 cars at once.

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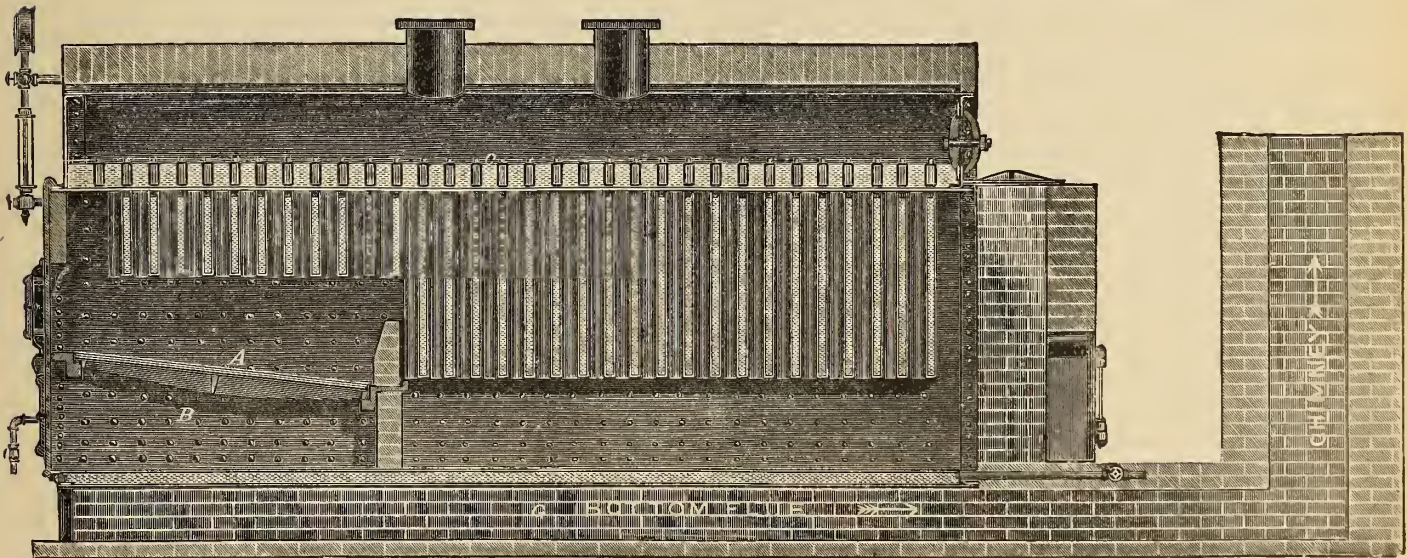
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SPARKS.

Mr. Alex. Brule, of Billings Bridge, Ont., was killed by being struck by a car on the Hull electric railway.

Messrs. Ahearn & Soper, of Ottawa, have secured the contract for twelve open cars and five closed cars for the Quebec Street Railway.

Mr. Harry Dennis, engineer in charge of the electric light plant at Bracebridge, Ont., was found dead in bed recently. Heart failure was given as the cause of death.

The city council of Hull, Que., will probably call for tenders at once for an electric light plant for lighting the city. It is estimated that 50 arc lamps will be required.

Messrs. Dawson & Symmes, of St. Catharines, Ont., intend applying to the City Council for an extension of time in which to commence the construction of an electric railway to Port Dalhousie.

Messrs. J. C. Wilson & Co., of Lachute, Que., have purchased from the Canadian General Electric Company, for the lighting of their premises, one of their standard $17\frac{1}{2}$ kilowatt multipolar generators.

The Metropolitan Railway Company are not likely to extend their railway beyond Bond Lake this fall. The committee appointed by the Aurora council to locate the line in the village has not selected a route satisfactory to the railway company.

Messrs. Bindon & McViety, of Ottawa, have lately commenced operations on a mica mine at Templeton. It is claimed that a market has been secured for large quantities of mica, and that experts have pronounced the production of the mine of exceptionally good quality.

Negotiations are still in progress between the city council of Hamilton, Ont., and the promoters of the Hamilton, Chedoke and Ancaster electric railway regarding the building of the road. It is hoped that, at an early date, a decision will be reached which will permit of the work being proceeded with.

The Canadian Oiled Clothing Company, of Toronto, have recently found it necessary to increase their factory premises, and have removed from Port Hope to Toronto. They have given an order to the Canadian General Electric Company for the installation of a 100 light incandescent lighting dynamo.

The city of London, Ont., has signed a contract with the London Electric Company for street lighting for ten years, at the price of 23 cents per night per lamp of 2,000 c.p., from sunset to sunrise, for 317 nights in the year, and whenever the city engineer orders for the other 48 nights. From 300 to 350 lights will be used.

Mr. A. Piers, superintendent of the C.P.R. Company's steamship lines, has placed an order with the Canadian General Electric Company for a direct driven unit, to be installed on the steamer Alberta. This consists of a 25 kilowatt generator, direct connected to a 9 x 10 Ideal engine. The order includes a marble panel, with standard instruments and wiring.

The Bell Telephone Company of Winnipeg are making improvements to their system, including the placing of safety cut-outs on each line just after it enters a building and the using of porcelain conduits at the point of entrance. Fuse blocks are also being placed above each telephone to protect the apparatus. These changes are claimed to be the result of the appointment of a city electrician.

The Hull Electric Company, of Hull, Que., are increasing their generating plant, and have purchased from the Canadian General Electric Company one of their well known standard monocyclic generators, having a capacity of 150 kilowatts, with marble panel switchboard and instruments complete. This makes the third machine of this size and type which this company have purchased.

The ratepayers of Galt, Ont., recently passed a by-law to expropriate the gas and electric light works. The authorities of the town have since discovered that there is no law on the Ontario Statutes sanctioning the expropriation of electric plants by municipalities, and it is probable that another by-law will have to be submitted before the council can even take over the gas plant. As to electric lighting, it is understood that an offer will be made to the Galt Electric Light Company for the purchase of their plant.

The Department of Electrical Engineering, McGill University, Montreal, are adding to their electrical equipment a number of special generators, motors, transformers and testing instruments, to be used in connection with their experimental work. They have placed an order for all their requirements in this respect with the Canadian General Electric Company.

L. Becigneul et Cie, Lake Megantic, Que., are installing an incandescent electric system for the town, and for that purpose have purchased from the Canadian General Electric Company one of their standard 30 kilowatt single phase generators, with marble panel switchboard complete. They have also placed an order with the same company for all transformers and wiring supplies required to carry out the work.

Mr. Edward S. Jenison, who is interested in the development of the water power of the Kakabeka Falls, on the Kaministiquia river, proposes to build a canal from above the Ecarte Falls, on the above river, to the boundary of Port Arthur, where he will build an immense storage reservoir. It is claimed that the water will be delivered under a head of 300 feet. The intention is that the towns of Port Arthur and Fort William shall get their water supply from this source, which will likewise give them a fire pressure by gravitation. Both towns are to be supplied with water sufficient to generate electricity to supply the Port Arthur electric railway and both lighting plants upon payment of a rate of one cent per thousand gallons, which will furnish power at a less rate than either municipality is now paying for their steam power. The cost of the canal is estimated at one million dollars.

PERSONAL.

Mr. Jas. Ross, vice-president of the Montreal Street Railway Company, arrived in Montreal during the past week from Liverpool, Eng.

It is understood that Mr. W. T. Goulding will be appointed manager of the G. N. W. Telegraph Co.'s office just opened at Vancouver, B.C.

Mr. W. H. Smith, of Goderich, Ont., has been appointed superintendent of the electric light and waterworks plants at Fort William, Ont. The electric light plant was installed by the town last spring.

Mr. Raoul D. B. Corriveau, son of Mr. A. J. Corriveau, late manager of the Montreal Park and Island Railway, Montreal, has returned to that city, and is now proceeding with his courses at McGill University. Mr. Corriveau was a member of the engineering party sent by the Dominion government on exploration to Magdalen Islands.

Mr. F. H. Badger, general manager of the Montmorency Power Co. of Quebec, has resigned his position, and Mr. Ed. A. Evans has been appointed manager of the amalgamated Montmorency Power Co., Quebec District Railway Co., and Quebec, Montmorency & Charleboix Railway Co. Extensive improvements are now being made at the power house at Montmorency Falls, in view of this amalgamation.

PUBLICATIONS.

The Pelton Water Wheel Company, of San Francisco, Cal., and New York, N.Y., have sent us a catalogue, in which special attention is called to the high standard which has been attained by the Pelton water wheels, used so largely in the United States. The numerous illustrations of the various applications of Pelton wheels are very interesting. Various tables are also printed.

"A Brief Synopsis of Our Course in Telephony" is the title of a little booklet received from the International Correspondence School, of Scranton, Pa. The instruction papers for this course were prepared, we are told, by Mr. Kempster B. Miller, one of the best known telephone experts, who is instructor in this subject. Every branch of telephony is taken up in a thoroughly practical manner.

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TRADE NOTES.

The C.P.R., Montreal, have purchased a two-phase induction motor from the Canadian General Electric Company.

The Lachine Rapids Company have placed another order with the Canadian General Electric Company for three-phase induction motors.

The T. Eaton Company, Toronto, has ordered a 50 h.p. automatic engine, for direct connection to dynamo, from the Robb Engineering Company.

Messrs. J. Robinson & Co., of Winnipeg, Man., have purchased a 10 h.p. slow speed 500-volt multipolar motor from the Canadian General Electric Company.

Messrs. Brigham & Ingram, of Stratford, Ont., have placed an order with the Electrical Construction Co. of London, Limited, for an 8 horse power motor to operate their wood yard.

The British Columbia Sugar Refinery Company, of Vancouver, B.C., have purchased from the Canadian General Electric Company one of their new type 25 kilowatt multipolar generators.

The Salvation Army Printing House, Toronto, have given an order to the Electrical Construction Co. of London, Limited, for a motor equipment, consisting of three direct-belted, slow speed (300 r.p.m.), multipolar, 7 h.p. motors and two 2 h.p. motors.

The Canadian General Electric Company have received an order from the T. Eaton Company, of Toronto, for one of their 25 kilowatt direct-connected generators, with marble switchboard. This makes the fifth unit which the T. Eaton Company have purchased from the Canadian General Electric Company, their entire establishment being lighted and operated from these installations.

The Economy Manufacturing Company, of 613 Washington Life Building, 141 Broadway, New York, have just completed the installation of their hydro-carbon gas fuel system at the plant of the B. Greening Wire Company, Limited, Hamilton. This plant was equipped under the superintendence of Mr. H. Etches, Mem. Inst. Mech. Eng., of 83 Front street west, Toronto, the local representative of the company in Canada.

Messrs. H. Cargill & Son, of Cargill, Ont., have decided to install an up-to-date electric plant for their requirements, to furnish light and power to their residences, mills, barns and warehouses, and have purchased a 500-light plant from the Canadian General Electric Company, together with several motors for operating machinery and elevators. Mr. Cargill, M.P., is thoroughly up-to-date in all his undertakings, and his electrical plant will be most complete.

The Robb Engineering Company, Amherst, N. S., have received an order from New York parties for two 300 h.p. engines for an electric railway in Australia. They are to be tandem compound, side crank pattern, and the dynamos will be direct connected. This company is working up a considerable export trade, having shipped during the past few months one 300 h.p. engine to England, three 250 h.p. to the Isle of Man, three 125 h.p. to Spain, and one 125 h.p. to Newfoundland.

The Goldie & McCulloch Company, of Galt, Ont., are supplying a steam plant to the Metropolitan Railway Company, for their new power house at Bond Lake. It consists of two cross compound condensing Wheelock engines of 350 h.p. each, with high pressure cylinder $17\frac{1}{2} \times 42$ " stroke, and low pressure cylinder 32×42 " stroke. The pulley fly-wheels are to be 18" diameter by 35" face. There will be four boilers, each 16' long by 73" in diameter, and each containing 90 tubes $3\frac{1}{2}$ " in diameter by 16' long, to be run at 125 lbs. pressure. There will also be two independent condensers, $10' \times 15' \times 15'$, two duplex pumps, $6' \times 4' \times 7'$, two 30" heaters, steam and exhaust pipes, etc.

LEGAL DECISIONS.

A JUDGMENT of importance to electric light companies has just been delivered in Montreal by Mr. Justice Charland. In October, 1897, Alfred Seguin, an employee of the Citizens' Light and Power Company, met his death while working on a high pole of the company. In her plea, the plaintiff, the widow, alleged that there was a force of 1,000 volts being carried by the wire, which was not properly insulated, and that the death of her husband was due to the negligence of the company. The defendants denied responsibility, pleading that the accident was due to Seguin's imprudence. The judge found that the death of Seguin was due to the negligence of the Citizens' Light & Power Company, which had not furnished him with gloves, with which he might have handled the wires safely; and he condemned the defendants to pay Mrs. Seguin the sum of \$1,500 with costs as compensation for her loss.

THE AMERICAN STOKER CO. VS. THE GENERAL ENGINEERING CO. OF ONTARIO, LIMITED.—The case came up in the Superior Court, Montreal, on an inscription in law by the defendant. The plaintiff, in its answer to defendant's plea, said that the letters patent were null and void, and did not disclose any new or useful invention susceptible of being the subject of a patent in Canada. The plaintiff, in his declaration, did not attack the validity of the letters patent held by defendant and referred to in the declaration, but simply alleged in paragraph 6 that the stokers manufactured and sold by plaintiff were not an infringement of any patent held or owned by the defendant, and in no way infringed any rights of defendant. The court held that the plaintiff could not in an action like the present, and by answer to defendant's plea, attack the validity of the patents held by defendant and referred to in its plea. Under the Patent Act, section 33, such right is only allowed to defendant when pleading to an action for the infringement of the patent, and such exceptional provision did not apply to the present case. The plaintiff, in its answer, did not allege any fact or default which, by the Patent Act or by law, rendered the patent held by defendant void. The plaintiff did not by its answer say that the patents of defendant referred to in the pleadings be declared void. The defendant's inscription in law was well founded, and it was maintained with costs.

JUDGE Tellier has recently rendered judgment in the case of Mrs. Dominica Delvero against the Montreal Park and Island Railway Company. The plaintiff, who resides in Italy, claimed, in her name, and in the name of her five children, \$5,000 damages on account of the death of her husband, who was killed while working in the service of the defendant company. Delvero was employed with a gang of other men in the construction of one of the company's lines. A platform car was used to carry rails from one point to another, and the men were in the habit, although against the rules, of getting on this car and allowing it to slide down the grade, when going for rails. On the day when the accident occurred, a big branch had been cut down from a tree, and was lying across the track, and as the men coming down on the platform car could not prevent a collision, having no break, they jumped off. In doing so, Delvero sustained injuries from which he died two days after. His widow then took out the present action. In rendering judgment, the Court held that it had not been proved that the deceased had been made aware of the rule forbidding the men to get on the platform car. Moreover, this order seemed to be pretty much a dead letter, and the use of the car for the convenience of the men themselves seemed to have been tolerated. Under these circumstances the company must be held responsible for the accident. In the absence of sufficient proof, the Court assessed the damage at \$1,000, and rendered judgment in favor of the plaintiff for that amount.

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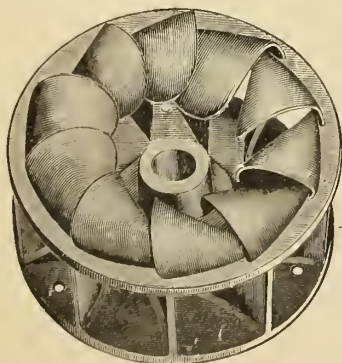
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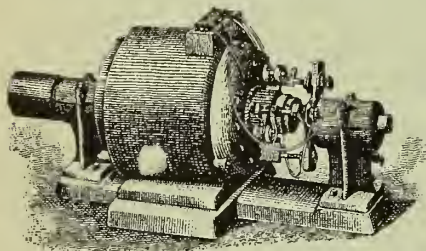
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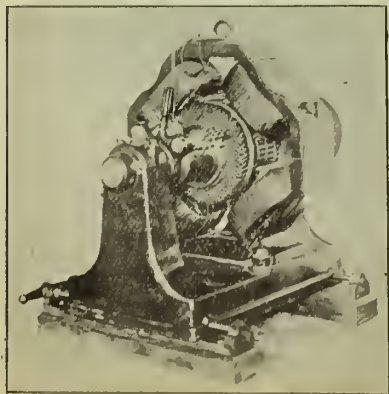
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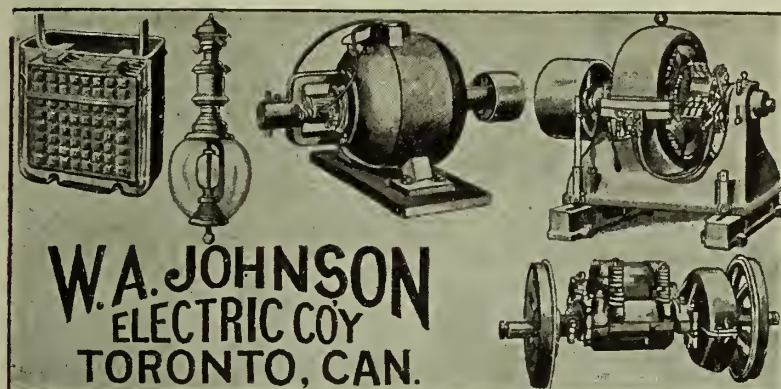
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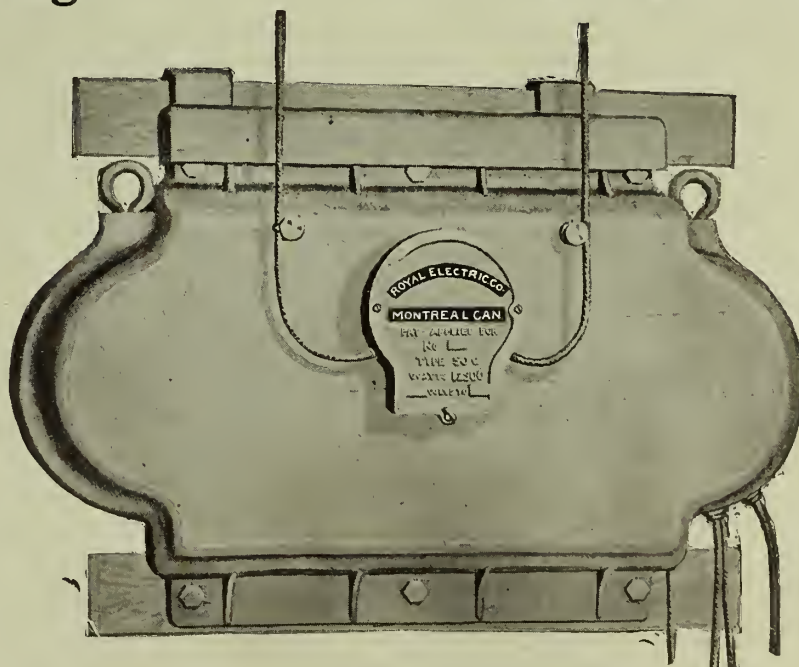
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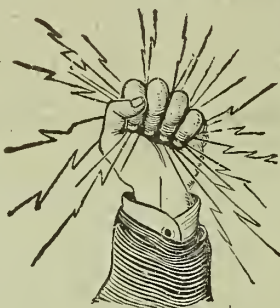


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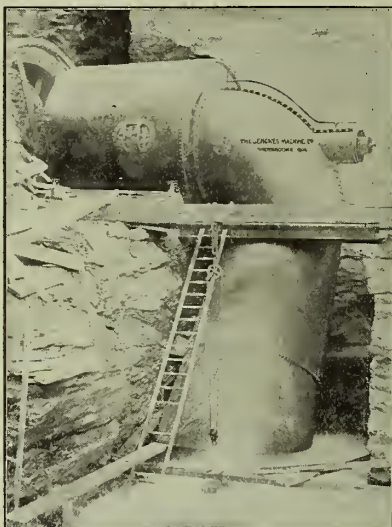
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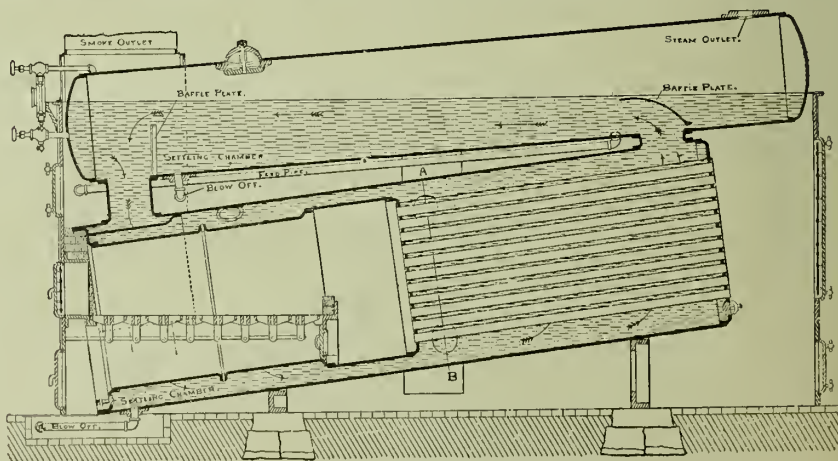
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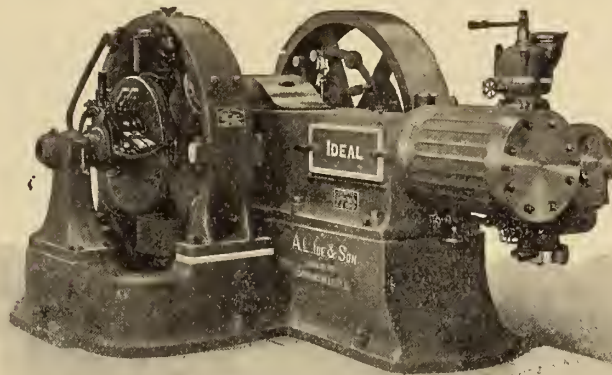
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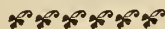
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(Sgd.)

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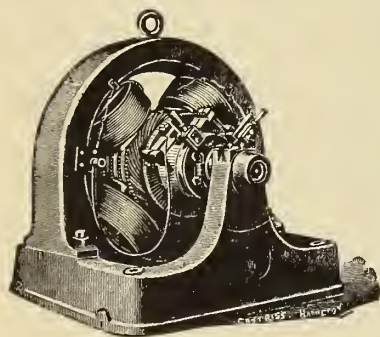
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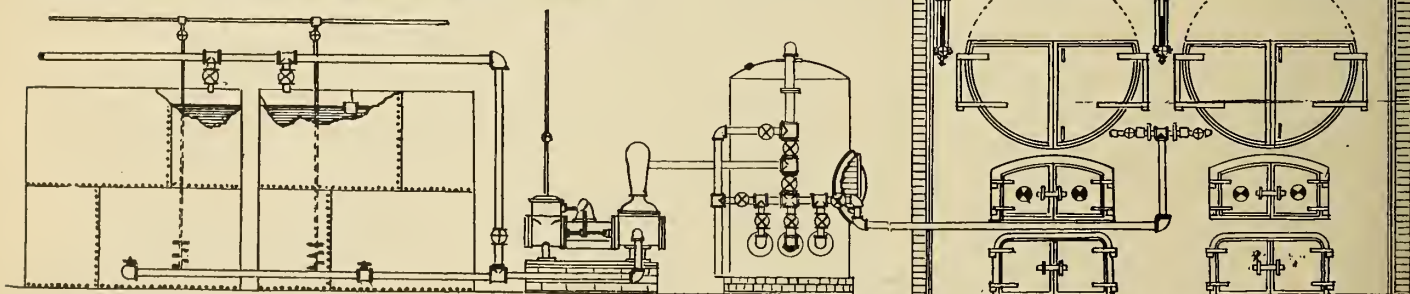
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CANADIAN
ELECTRICAL NEWS
AND
STEAM ENGINEERING JOURNAL.

VOL. VIII.

DECEMBER, 1898

No. 12.

**THE CATARACT POWER COMPANY
OF HAMILTON.**

Description of an Important Canadian Electrical Enterprise.—
Demonstration of the Practicability of Long Distance Power
Transmission.

SATURDAY, November 12th, will go down, in the electrical annals of Canada, a red letter day, as it will chronicle the formal opening of the electric power plant of the Cataract Power Company of Hamilton, Limited, for the transmission of electrical energy from a point on the Niagara escarpment, near DeCew Falls, to Hamilton, a distance of 35 miles, the conception and carrying out of which must always stand as a monument of business pluck and enterprise on the part of those interested in and forming the Cataract Power Company.

Over three years ago, when the transmission of energy by electricity over long distances for commercial purposes was still in much of an experimental

stage, the possibility of utilizing the magnificent fall of over 200 feet, obtainable at DeCew Falls, where the waters of the Beaver Dam creek tumble over the Niagara escarpment, for the generation of electrical energy to be transmitted to the city of Hamilton, 35 miles distant, suggested itself to Mr. John Patterson, of that city. After numerous surveys and examining into the physical feasibility of the scheme, he associated with himself the Hon. J. M. Gibson, John Moodie, sr., James Dixon and J. W. Sutherland, all well-known citizens of Hamilton. Together they procured a charter and formed the Cataract Power Company of Hamilton, Limited, for the purpose of the development of this power and the transmission of it to Hamilton.

After the formation of the company the ground was again gone over carefully, and it was found advisable to abandon the original idea of utilizing the waters and

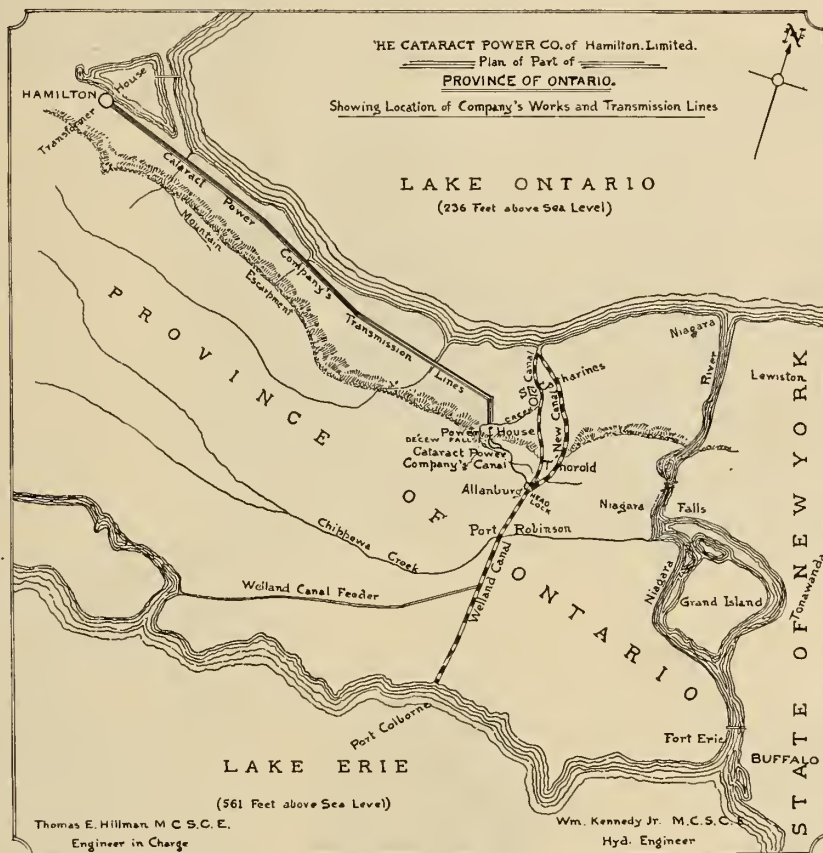
water-ways of the Beaver Dams creek and the DeCew Falls, and by changing the plans some very material advantages were gained :

First, the securing of a supply of water which would be constant, through a feeder from the Lake Erie level of the Welland Canal at Allensburg.

Second, the construction of a canal, $4\frac{3}{4}$ miles long, over private right of way, thus giving the company an unobstructed water-way.

Third, the securing of land along the private water-way for storage basins, by which the company can conserve its water at a period of non use or light load for use at the time of heavy load.

Fourth, by going three-quarters of a mile east of DeCew Falls along the Niagara escarpment, an additional fall of 70 feet was obtained, which was a very valuable acquisition. At this point there were also exceptional natural advantages, both at the top of the escarpment for the anchorage of flumes, erection of penstocks, etc., and at the foot of



it for the discharge of the tail water, as well as a splendid site for the power house.

The hydraulic development, as it was desired by the Cataract Power Company, presented obstacles which, owing to the large units and to the high head, made it exceptionally difficult to secure a builder of water-wheels who would give what the hydraulic engineer's specifications called for. After a long delay and much negotiation the Stilwell-Bierce and Smith-Vaile Company, of Dayton, Ohio, agreed to build special horizontal turbines of about 2000 horse power each, to work under a head of 265 feet, and to operate at a speed of 400 revolutions per minute. This required, also, special valve and valve gear and controlling devices, all of which were specially designed for this particular plant.

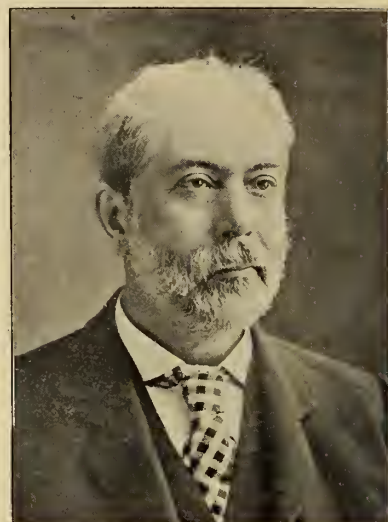
The generation of the electric power and the transmission of the same from the power house to the City of



MR. JAMES DIXON,
Vice-President.



MR. JOHN PATTERSON,
Secretary and Original Promoter.



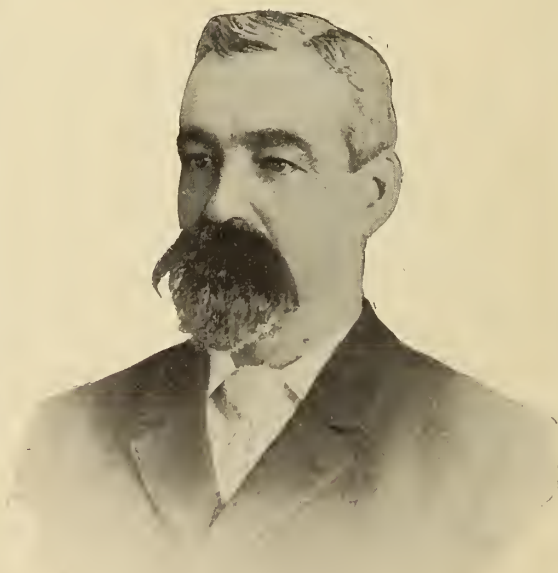
MR. JOHN MOODIE,
Treasurer.



HON. J. M. GIBSON,
President.



MR. J. A. KAMMERER,
Electrical Adviser.



MR. JOHN DICKENSON, M.P.P.



MR. J. W. SUTHERLAND.

DIRECTORS OF THE CATARACT POWER COMPANY OF HAMILTON, LIMITED.

Hamilton, a distance of 35 miles, presented at that time a seemingly insurmountable obstacle to the carrying out of the scheme, no transmission of energy such a long distance, for commercial purposes, having up to that time been undertaken. The largest electrical concerns, both in Europe and America, were consulted, but the limitation of a practical working pressure, sufficiently great to insure the transmission of power such a long distance, practically precluded the undertaking of the

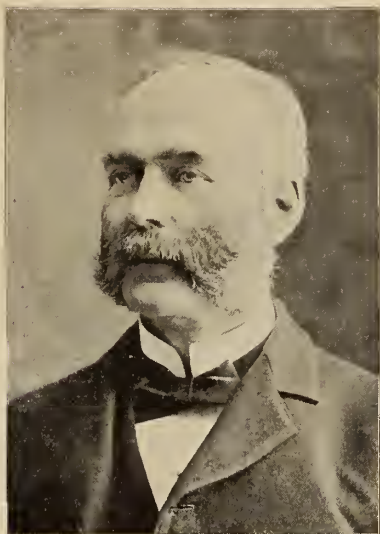
undertake the work which, with its consequent saving, brought the cost within the limits, deemed necessary by the Cataract Power Company to admit of the enterprise being proceeded with.

Ground was first broken on October 5th, 1897, and the work pushed with such vigor that the current was sent over the lines from DeCew Falls to Hamilton, on the afternoon of August 25th, 1898, or just 10 months and 10 days from the beginning of the undertaking.

THE CANAL.

The water for this plant is secured through a feeder from the Lake Erie level of the Welland canal at Allanburg. The arrangement of the gates, as shown in Fig. 1, is such as to admit of the unwatering of the lower levels of both the old and the new Welland canals without interfering with the company's supply of water.

From Allanburg the company has a private canal extending northwesterly to the edge of the Niagara escarpment, a total distance of about four and one-half miles. At three different points there are placed gates for regulating or shutting off the supply, so that the water is under complete control. Where the canal crosses the Beaver Dams creek, the water is carried in a closed wooden flume supported on a steel truss. This flume, which is



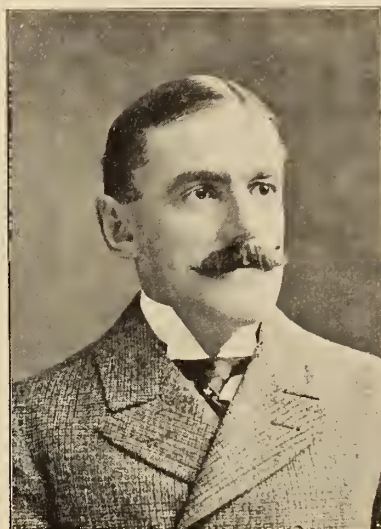
MR. WM. KENNEDY, JR., M.C.S.C.E.
Hydraulic Engineer.

work by any of the companies consulted, the highest working pressure, up to that time, being not above 10,000 volts. At this pressure the cost of the transmission line became so great that the Cataract Power Company did not feel warranted to undertake the development of the enterprise. The longer the distance, the heavier the conductor must be; therefore to transmit over this long distance, it was necessary that the pressure be 20,000 volts or over, so that the cost of the conductor would be within the limit set, to allow the Cataract Power Company to undertake the development of the enterprise. After nearly a year of futile



MR. THOS. E. HILLMAN, M.C.S.C.E.
Engineer in charge.

attempts to have the work undertaken at a pressure which would justify them in proceeding with the work, and being unsuccessful, they consulted Mr. J. A. Kammerer, one of the staff of the Royal Electric Company, of Montreal, and after careful consideration of the conditions, and preliminary estimates of cost prepared by him, with a working pressure of 24,000 volts guaranteed, the Royal Electric Company agreed to



MR. H. R. LEYDEN,
General Manager Cataract Power Company.

shown in Fig. 2, is placed below the level of the water in the canal at each end so that the contained water is always under pressure, which is intended to prevent leakage. The water follows generally the water courses of a succession of small streams, consequently there are few heavy cuts or fills. In a number of places the contour of the ground formed a natural bed for the canal, and no work was necessary. At the heavy cuttings the banks to the bottom of the canal are pitched with stone, and the important embankments are rip-rapped to prevent erosion.

At the lower end of the canal near the mountain top are located three large storage reservoirs, having a total area of thirty-three acres. Two of these, known as lakes Moodie and Gibson, are shown in Figures 3 and 4. These three reservoirs are sufficient to contain forty-eight hours' supply of water, and will meet the hourly inequalities of demand usual in electric supply companies, as well as allowing the unwatering of the upper stretches of the canal for repair purposes, without the interruption of the company's service. Throughout the whole length the work is of particularly substantial character, the factor of safety being exceptionally large,

and the requirements of the service seem to have been carefully considered.

The large reservoirs, being located immediately at the mountain's edge where the water enters a steel pipe, the long stretches of slow current canal will, it is expected, promptly freeze over and prevent any trouble from frazil or anchor ice. In this matter the water

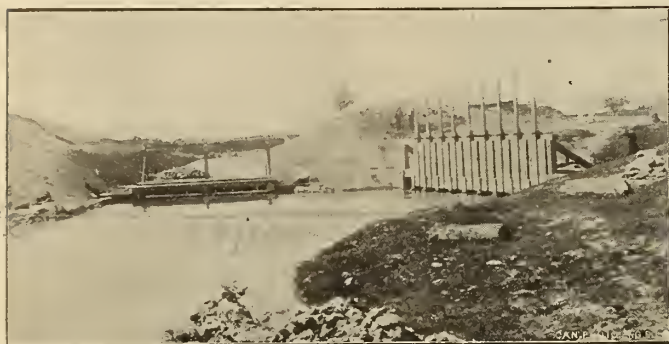


FIG. 1.—ARRANGEMENT OF HEAD GATES.

power is particularly fortunate, as there is practically dead water to Lake Erie. The canal is designed to carry sufficient water to develop from 10,000 to 12,000 horse power without creating an erosive speed in the current. The waterways and appurtenances were constructed by Messrs. Angus McDonald & Company, under the supervision of Thos. E. Hillman, C.E., resident engineer, and under the general approval of Mr. Wm. Kennedy, jr., of Montreal, engineer in chief.

THE PIPE.

At the brow of the mountain the water is delivered through a concrete fore bay, protected by suitable racks and head gates, to a large steel pipe which carries it directly down the mountain slope to the power house, two hundred and sixty feet below. The pipe is of steel plate, double rivetted on both longitudinal and transverse seams. It is 745 feet in length and varies in diameter from 8 feet 6 inches at the top to 7 feet 6 inches at the bottom. The steel used for the top section is $\frac{1}{4}$ inch in thickness and gradually increases in size down the slope until at the bottom it is $\frac{13}{16}$ of an inch. The weight of this pipe is all supported from the top, where a number of heavy flanges are built into several piers of concrete placed in the rock cutting. Down the slope, at intervals of fifteen feet, supporting masonry foundations are constructed. A substantial double housing of matched lumber is now being built



FIG. 2.—FLUME OVER BEAVER DAMS CREEK.

over the entire length to protect the pipe from extreme changes of temperature.

About two-thirds of the way down the slope is placed an expansion joint to take care of any elongation or contraction. In addition to serving this purpose the joint is so designed as to support the part of the pipe below it. This is accomplished by means of the water

pressure acting against an annular piston attached to the lower section, the piston working in a cylinder attached to the upper section.

From the top the pipe runs downward at an angle of about twenty degrees for about two-thirds of its length, where it reaches a level bench about sixty feet wide and then continues downward at the same slope to the bottom, where it turns with a gentle curve almost a right angle and extends underneath the floor of the power house.

POWER HOUSE.

The power house building (Fig. 5) is a substantial structure of iron and brick, 174 x 42 feet, with a galvanized iron roof over matched board sheathing. It is designed to accommodate four complete generating units and the necessary step-up transformers, switchboards, etc. Only two units and half the capacity in transformers are at present installed. The building is lighted by clusters of incandescent lights and will be heated by electric heaters.

The main supply pipe enters at the end of the building below the floor level, and inside the building widens out into a steel receiver ten feet in diameter, which is solidly imbedded in concrete underneath the floor. From this receiver four branch pipes come up through the floor with a quarter turn for delivering water to the turbines. In these branch supply pipes are placed large vertical hydraulic gates. These gates are 36" in diameter, and are operated by hydraulic pressure by means of a four way valve, controlled by a lever. These valves



FIG. 3.—STORAGE RESERVOIR NO. 1—LAKE MOODIE.

will open or close in less than a minute. The gates, as well as all the hydraulic machinery, were supplied by the Stilwell-Bierce and Smith-Vaile Co., of Dayton, Ohio. Beyond each gate valve is placed a 12" spring relief valve, to relieve the pressure when it exceeds that due to the normal static head. The turbines are 1,950 h.p. each, and run at 400 revolutions under the normal head of 280 feet.

The water wheels are of the inward flow central discharge reaction type, with cylinder gates. We believe that this is the highest head employing this type of turbine, most of the high head plants using the jet or impulse, peripheral bucket design wheels. In order to withstand the unusual pressure, the runners, the gates and all parts susceptible to wear are made of bronze, and everything is made extremely heavy and has been specially designed for this plant. The water enters the wheel horizontally and discharges vertically downward through a draft tube 14 feet in height. Each unit is equipped with a Stilwell-Bierce and Smith-Vaile electric governor of the Giessler design for controlling the speed. On the outer end of the shaft is placed a $7\frac{1}{2}$ ton steel fly wheel with an outboard bearing. The combined influence of the enlarged receiver, the relief valves and the heavy fly wheels is

calculated to overcome any tendency to water hammer.

ELECTRICAL EQUIPMENT.

The Royal Electric Co., of Montreal, designed and planned the entire electrical equipment, which marks a long stride forward in the progress of electrical engineering as applied to the transmission of energy. All the electrical machinery and apparatus were supplied by that company, and manufactured at its shops at Montreal, and in character and finish are examples of Cana-

the instruments are made of ground glass and present a very attractive appearance. The exciter panel contains the usual instruments for operating two shunt-wound direct current machines in parallel, and also contains the synchronizer, which is of the ordinary three lamp type.

A special feature is the absence of generator fuses. As the S.K.C. generators supplied were made especially by the Royal Electric Company to withstand a heavy overload, it was considered safer to risk the strain upon the generators due to a short circuit rather than, by the blowing of generator fuses, to cause the instant removal of the entire load from the water wheels.

Immediately back of the switch-board and taking up one end of the building are located ten of a new type of S.K.C. transformers, used to raise the potential relieved by the generators to 22,500 volts on the transmission line, at which pressure it is at present operated. These transformers are arranged in batteries of five, each transformer having a capacity of 200 k.w. They are artificially cooled by means of water pipes supplied directly from the penstock, the pressure being re-

duced by means of throttle valves. The transformers are encased in tanks made of steel boiler plate and rest directly on the concrete floor. The coils are wound in sections carefully insulated and separated by unusually large air spaces, and the whole immersed in mineral-seal oil. This construction has been found to admirably answer the purpose of this exceedingly high voltage, each transformer being tested with a break down strain of 40,000 volts before being installed.

A novel feature of the installation is the switchboards which accompany each transformer. They are of specially selected white marble and contain two single pole high voltage switches and one double pole 2,000 volt switch, the two high voltages being separated by a marble barrier. The high voltage switches consist of a flexible cable, having a screw plug attached to one end and a socket to the other, the socket being attached to

dian manufacture highly creditable. The generators, illustrated in Fig. 6, are of their well-known S.K.C. inductor type, generating two-phase current at 2,000 volts, running at 400 revolutions per minute. Each of the two generators at present installed is of 1,000 k.w. rated capacity. They are connected direct to the turbine shaft by means of an insulated flexible coupling composed of two flanges with projecting pins, the alternate pins being joined by sole leather links. The generators rest on base frames of seasoned Georgia pine to insulate them from the foundations. The inductors of these machines weigh over twelve tons, which weight running at such a high speed, requires most careful workmanship. The entire absence of vibration and general smoothness of operation is certainly creditable to the manufacturers.

The wires connecting the generators to the switch-board are laid in conduits in the floor, which are covered with iron griddles so that they are accessible at any point.

There are two exciters of 30 k. w. capacity, each driven by a separate turbine. Each exciter is calculated for supplying the full equipment of four generators. They are likewise directly connected to and insulated from the turbines. A view of the exciter unit is shown in Fig. 7.

The main switchboard, as shown in Fig. 8, is made up of three white marble panels, one for each generator and one for the exciters. On the generator panels all the connections are made on the back of the board, there being no terminals on the face. The switches are of the S.K.C. slide quick break type and are provided with automatic shutters to prevent arcing. They are double throw, connecting to two separate sets of bus bars so that the machines may be run on separate lines or in parallel, according to the future requirements of the service. Each generator panel contains a volt meter with a double throw switch connected to both phases, an ampere meter on each phase and a direct current ampere meter in the field circuit of the generator. The cases of



FIG. 4.—STORAGE RESERVOIR NO. 2—LAKE GIBSON.



FIG. 5.—GENERAL VIEW OF POWER HOUSE AND PIPE.

a hardwood pole four feet in length for safe handling. The socket and the plug which it fits over are tipped with non-arcing metal. By means of these specially constructed switches the 22,500 volt circuit can readily be opened. The low voltage switches are of the S.K.C. slide quick break type on the back of the switch-board. Each transformer is also equipped on both the primary and secondary sides with enclosed non-arcing fuses. The 22,500 volt wires inside the building are all covered with a specially heavy insulation of rubber and

are supported on porcelain line insulators on an overhead rack, all being in plain sight and easily accessible.

From the transformers, which are connected five in parallel on each phase, the circuit runs to the line terminal board, consisting of four high voltage switches similar to those placed on the transformer, except that they have double terminals, in order that they may be changed to either of the two lines contemplated by the company. Immediately above the line terminal board is placed a specially constructed lightning arrester equipment, composed of 60 S.K.C. non-arcing arresters with their special appurtenances and connections. From the lightning arresters the wires pass upward and out through the wall of the building at a height about 30 feet from the floor.

THE TRANSMISSION LINE.

The high voltage wires are carried through the brick wall forming the gable of the power house, by means of lead encased rubber covered cable, protected by vitrified pipe, the cable being kept clear of the pipe by wooden bushings specially prepared in oil. After passing over a cross-arm attached to the building, the lead covered

The poles are all specially selected, with 8" tops and not less than 35 feet in length. They are set 90 feet apart and 6 feet deep in the earth. The height of the poles varies with the contour of the ground, so as to keep the wires as nearly horizontal as possible. In marshy places a crib filled with stone is built around the base of the pole, and where the line crosses the Jordan river the poles are placed in a cluster of piles specially driven for the purpose. On the top of the poles is run a galvanized iron barb wire grounded at every pole by means of an iron plate for lightning protection. Below the transmission cross-arm is placed a two-pin cross-arm carrying the telephone circuit.

The telephone circuit is a complete metallic circuit of No. 10 B. W. G. galvanized wire, transposed at every fifth pole. This arrangement has been found to give satisfactory service with the heaviest currents yet passed over the line.

The insulators were all carefully tested with a breakdown pressure of 60,000 volts, both at the factory and again at Hamilton before being put up, with the satisfactory result that not one has broken down, or pro-

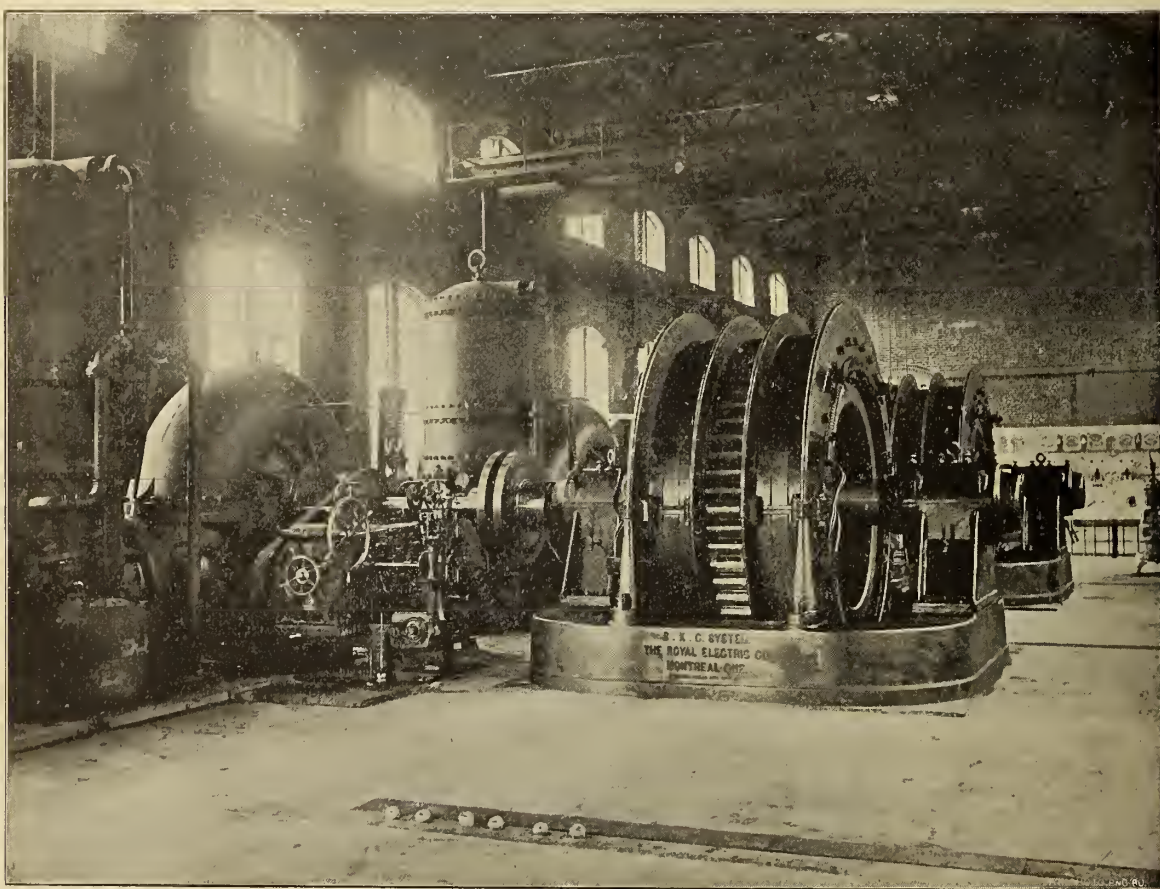


FIG. 6.—INTERIOR OF POWER HOUSE, SHOWING GENERATORS.

cable is joined to the bare copper transmission wires, by means of a long carefully made water-proof joint. This special construction has proven entirely satisfactory.

From the power house the transmission line crosses the Twelve Mile creek and runs up the hill opposite on private property, to a concession road, thence along this roadway due north to the Grand Trunk Railway and then westward along the railroad right of way on an almost perfectly straight line to the company's step-down station at Hamilton, a total distance of a little less than 34 miles. The transmission wires are four in number, and are No. 1 B. & S. medium drawn bare copper. They are all placed on one four pin cross-arm $3\frac{3}{4} \times 5\frac{3}{4}$ ", spaced 18" apart, and are supported on porcelain insulators of the Redlands type, supplied by the Imperial Porcelain Co. The pins are of special design, holding the insulator two inches higher from the cross-arm than the standard practice. This is to avoid trouble from heavy snow or sleet. The pins are of yellow locust specially prepared in oil and are fastened into the cross-arm with a wooden pin instead of being nailed, so as to use as little iron as possible.

duced the slightest trouble in the three months during which the line has been in operation, notwithstanding the unusual rain and sleet storms during that period.

The construction of the pole line was executed by Messrs. Lowe & Farrell, of Hamilton, the Cataract Power Company supplying the material. This work has been executed in a very creditable manner.

TRANSFORMER SUB-STATION AT HAMILTON.

The company's step-down station (see Fig 9) is located on Victoria avenue, immediately beside the Grand Trunk Railway's right of way, about one mile within the city limits. It is a neat structure, built of brick, with a slate roof and specially designed for its purpose. At this point the voltage is reduced to 2,000 volts, at which pressure the current is distributed through the city in four separate circuits.

The line wires are carried through the brick walls of the building in the same manner as at the power house. There is the same arrangement of lightning arresters, high voltage lines and two batteries of transformers. The transformers, however, are arranged so as to be

artificially cooled at times of heavy load by an air blast. The transformers rest over an air duct in the floor and are provided with a ring of vertical air ducts passing up through the oil. The blast arrangement, which consists of a No. 6 Sturtevant blower, direct connected to an S.K.C. two phase induction motor, delivers air directly

& Power Co.'s service, the Cataract Power Company have already contracted for a large amount of power for operating factories of different kinds in the city. They expect within a short time to supply the various electric railways in and about Hamilton and to replace many of the steam engines in the various manufacturing establishments with electric motors.

The plant has been in practical operation for several months, and has thoroughly demonstrated the success of electrical transmission at this high voltage and long distance, which speaks well for the carefulness in designing and construction of the work.

The officers of the company are: Hon. J. M. Gibson, president; James Dixon, vice-president; John Moodie, treasurer; John Patterson, secretary; H. R. Leyden, general manager, the latter having had general charge of all the construction operations. Portraits of these gentlemen, as well as of the other directors

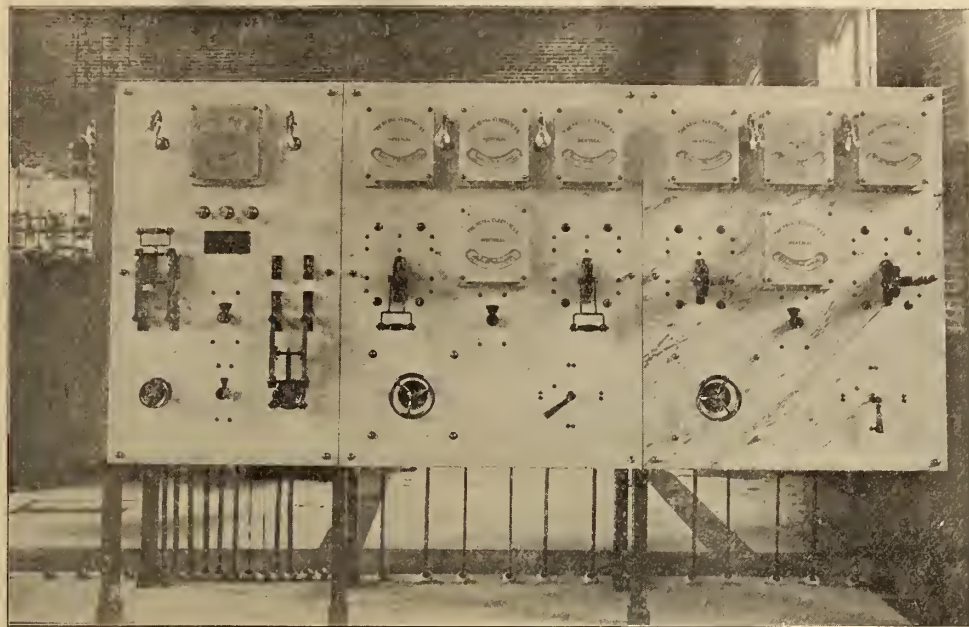


FIG. 7.—GENERATOR SWITCHBOARD.

into this duct, which then passes upward through the transformers.

In the transformer room is also placed the distribution switchboard, and, as at the power house, only half the ultimate capacity of the transformers has been installed, the building being designed to accommodate two more batteries of five, similar to those already placed, consisting of four panels each, containing two ampere meters, two double pole double throw switches and four duplex fuse blocks. From this distribution switchboard incandescent lighting current is supplied for the Hamilton Electric Light & Power Company, as well as for motors on premises of customers throughout the city. From the switchboard the circuit wires pass upward to a cupola in the roof, at which point they are joined to the distribution circuits. The line supplying the incandescent service is a four-wire two-phase circuit, but the circuits devoted exclusively to power are composed of three wires only. An interior view of the transformer station is presented in Fig. 10.

At the premises of the Hamilton Electric Light & Power Company is being installed a new circuit switchboard, arranged to accommodate the old single phase lighting circuits of this company. Each circuit is equipped with a double throw switch in order that the load may be divided with a regulating transformer, so that the pressure may be controlled upon this point. The old house-to-house 1000 volt 16,000 alternation transformers have all been replaced by new S. K. C. 2000 volt 8000 alternation transformers in larger units, and the service all changed to this higher pressure in order to reduce the losses and obtain better regulation.

In addition to supplying the Hamilton Electric Light

of the company, will be found elsewhere in this number.

FORMAL OPENING.

Although the plant above described had been in operation for some time, it was not until Saturday, November 12th, that the formal opening took place. In response to the invitation of the Cataract Power Company, some 200 persons, chiefly business men of Hamilton, gathered at the Grand Trunk station in that city, and were taken by special cars to St. Catharines, where carriages were in waiting for conveying the guests to the power house, about three miles distant.

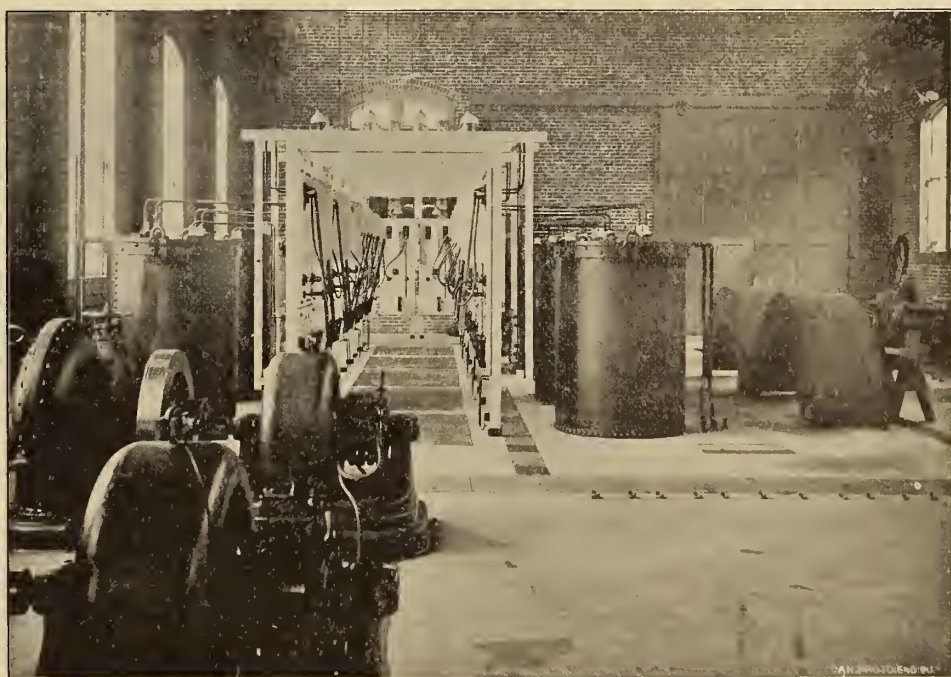


FIG. 8.—HIGH VOLTAGE SWITCHBOARD, STEP-UP TRANSFORMERS AND EXCITERS.

Here an hour was spent in an inspection of the plant, which was running at full speed, after which the visitors were invited to partake of luncheon. Tables had been arranged in the reserve space in the power house. A sumptuous repast was served, and no evidence was lacking that the hospitality of the directors of the company was fully appreciated. The

closing down of the machinery signalled that some remarks were forthcoming. Hon. J. M. Gibson, in a few words, expressed his pleasure at being accorded the privilege of presiding upon an occasion which marked the inauguration of so important an undertaking. He announced a brief toast list, which elicited replies from Mayor Colquhoun, Ald. Carscallen, Messrs. A. T.



FIG. 9.—SUB STATION AT HAMILTON.

Wood, M.P., T. H. Macpherson, M.P., John Stuart, W. F. Maclean, M.P., Wm. Gibson, M.P., John Moodie and others. Returning to Hamilton about 7 p.m., a visit was made to the transformer station, where further speech-making was indulged in.

Mr. James G. Pennycuik, of Toronto, has invented a glass conduit for the conveying of electricity without material loss of power.

Mr. H. H. Pratt, Superintendent of Construction for the Central Construction Company, Buffalo, N.Y., was recently in Toronto and called at the office of the ELECTRICAL NEWS. Mr. Pratt informs us that his company are engaged in power plant construction, including water, steam and electric, and that it is the purpose to give greater attention to Canadian business.

Mr. J. J. Wright, manager of the Toronto Electric Light Co., recently visited Fenelon Falls, Ont., for the purpose of obtaining data upon which to base a report regarding the practicability of the proposal for the transmission of electric energy for light and power to Lindsay. Mr. Wright was engaged by gentlemen who have been asked to provide the capital necessary to carry out the scheme.

The annual statement of the Montreal Street Railway Company, for the year ending September 30th, 1898, has been submitted to the shareholders. It shows net profits of \$601,704.18, as compared with \$507,855.60 for the previous year. This is equivalent to an earning power of 13% on a capital of \$4,700,000. After paying a dividend of 10%, \$138,000 was carried to rest account. The rolling stock was increased during the year by the addition of 22 closed motor cars and 60 open motor cars, all constructed in the company's shops. There are also under construction at the present time 115 cars for next summer's traffic, together with 10 sweepers. The cost of road and equipment construction thus far has been \$2,901,959.38, and of equipment \$2,093,061.47.

Mr. R. C. C. Tremaine, B.A. Sc., of the Exeter Electric Light and Power Co., in remitting subscription to the ELECTRICAL NEWS, writes: "I am glad you continue it, both on my own account and that of my men, who take great interest in its practical articles."

MONTREAL.

(Correspondence of THE CANADIAN ELECTRICAL NEWS.)

The new theatre, "Her Majesty's," is now open, lit electrically from Lachine power. The switchboard is of the standard Cushing (Boston) type, somewhat similar to that of the Knickerbocker Theatre, New York. Dimmers are interlocking.

As winter approaches, Montreal abounds with the electric belt fiend and similar "parasites." Such articles, of course, prevent everything from consumption to broken limbs. The fools of this city are not all dead yet apparently, as the industry is evidently in a healthy (?) condition.

The Merchants' Cotton Co. are equipping their new wing electrically with 1,000 lights, 21 station watchmans' detectors, and some private 'phones. The work is in the hands of the Montreal Electric Co., who are using Crocker-Wheeler generator and Eco Magneto watchman's detector in their contract.

W. C. McDonald has again been McGill's benefactor in putting his hand in his-pocket for new electrical apparatus. This will be greatly appreciated by the new professor of electrical engineering, for although the present laboratory is fitted with good apparatus, yet it cannot be classed as up-to-date by any means.

It is with regret that we learn of the departure of Mr. Gonzenbach, of the engineering staff of the Royal Electric Co. He goes to take a position with the Westinghouse Co. at Pittsburg, where we have no doubt his sterling qualities will commend him. He left numerous friends here,

and was well liked by the trade.

At the ball lately given by Mrs. Meighen, 140 Drummond street (formerly the residence of Lord Mount-Stephen), an unique effect of lighting the main staircase and hall was produced with reflectors placed outside of the stained glass windows and ornamental skylight. As the art glass was exceedingly handsome, and the lights not spared, the effect was excellent. The job appears to be in for all time, as the rubber lead encased wire is laid firmly outside the house on the limestone, and does not make an unsightly piece of work either, as the lead makes a fairly good match as regards color to the stone.

That the Electric Street Railway has benefitted Montreal to a great extent cannot be denied, yet some of their arrangements, to

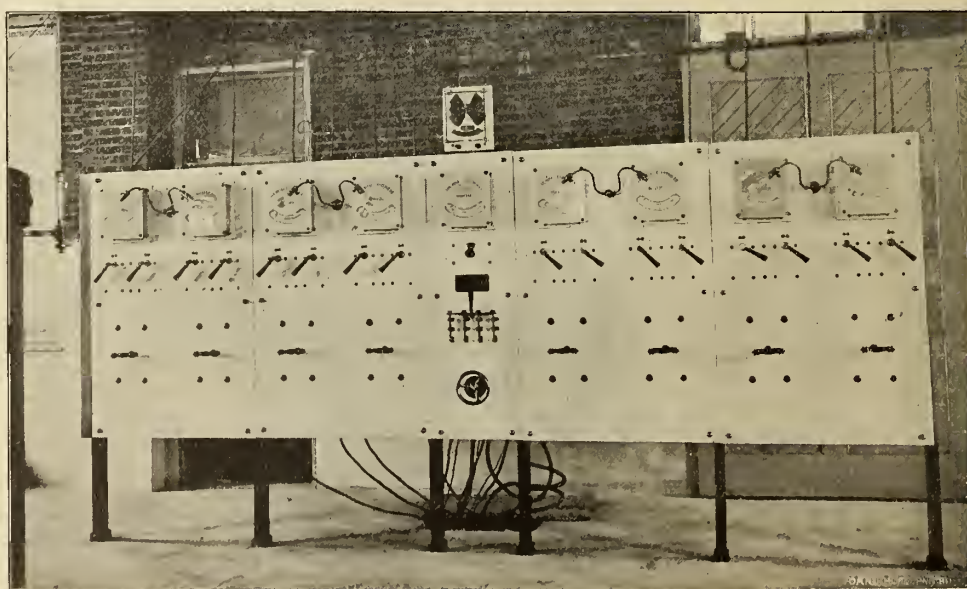


FIG. 10.—SUB-STATION DISTRIBUTING BOARD.

those not initiated into their official mysteries, are hard to explain, viz.: The Windsor and St. Lawrence route is apparently the most paying one, and its patrons the most dangerous "kickers" if they should be put to it, and yet every evening cars loaded to the muzzle proceed out St. Catharine street west from down-town, whereas this very traffic could easily be relieved by a few cars run out St. James street west and up the Guy street line, which latter is

not used to any great extent, and will not be until the government give permission to cross the bridge at Seigneurs street.

The system of supplying current to several installations from one large transformer, although economical from the power company's point of view, can hardly be called a "good thing" just yet. Several houses are wired as per old underwriters' rules, and have no main cut-out; possibly among some of these stands one "up-to-date," yet by being connected with afore-mentioned ones (possibly grounded) the modern installation partakes of the faults of the old ones. As to the installations without main cut-out, what would happen were a short circuit to occur on their interior mains?

MCGILL UNIVERSITY NOTES.

Prof. Owens, head of the electrical department of McGill University, accompanied by the students of the Department, visited Peterborough on the 2nd inst. for the purpose of inspecting the extensive workshops of the Canadian General Electric Company at that place.

Mr. Insull, president of the Chicago Edison Company, has consented to deliver a lecture to the students of the Electrical Department of McGill University about the middle of February. I am not able at present to give your readers the title of the lecture or the exact date of its delivery, but hope to do so later on.

The authorities of McGill University propose to substitute for the degree of B.A.Sc. (Bachelor of Applied Science) that of B.Sc. (Bachelor of Science), as being one more readily understood by the public. The Gazette remarks that the dropping of the word "applied" will also take away the opportunity now afforded (and not altogether neglected) for hostile critics to represent the training in this faculty as merely technical. While the faculty prides itself on turning out professional men as competent as college training can make them, the teaching is scientific in spirit throughout, and is founded on a basis of pure science which takes up a large part of the course.

AN ELECTRICIAN'S LUCK.

A well-known electrician of this city is now the possessor of a gold-headed cane, which came into his keeping in a most peculiar manner. While visiting the Toronto Industrial Exhibition last autumn, he got into the midst of a crowd who well-nigh squeezed each others' life out in an attempt to gain entrance to the grand stand. When the Montrealer emerged from the crush, he was not only surprised to find his bones intact, but also that somebody had come out of the scrimmage minus a gold-headed cane, which, in the absence of its owner, he felt free to appropriate.

ELECTRIC TRACTION ON STEEL RAILS.

ALTHOUGH several more or less important works have already been published under the above title, so far none have treated exhaustively the subject of electric traction as a topic by itself; all have neglected it for the fuller treatment of the widely different questions of energy and distribution to the rolling cars. Many engineers, therefore, who are not satisfied with superficial notions on the subject, complain at not finding, in technical works purporting to deal with the matter, sufficient data touching the conditions to be realized so far as electric motors and rolling stock are concerned.

The recent treatise on "Electric Traction on Rails," by Andre Blondel and Paul Dubois, is intended to fill this want in the electrical literature. In this it has succeeded remarkably, covering the field broadly, not only as to the variety of subjects dealt with, but as to the manner in which the different aspects of each particular subject or development is treated.

This work has been conceived in two main divisions, treating respectively (1) of the rolling stock and appliances in all classes of service, and (2) of the technical discussions of traction proper. The authors have added, as natural complements of the subject, a practical study of the track in the first part, and a careful exposition of the several methods of braking in the second, not only from a mechanical, but also an economical point of view. Two important appendices attached to the first volume treat respectively of the various costs and running expenses, and of the private and public precautions of safety. Numerous indexes added to the second volume give valuable information on specifications, designs of motors and other appliances.

Mr. George H. Cooper, of Oakville, Ont., in remitting his subscription to the ELECTRICAL NEWS, writes; "I find it one of the best mechanical magazines that I have ever read."

CANADIAN ELECTRICAL STUDENTS' COMPETITION.

THE publishers of the CANADIAN ELECTRICAL NEWS hereby offer a first and second prize of \$15 and \$10 respectively for the best thesis submitted by an undergraduate of a Canadian university on any one of the following subjects, viz.:

1. "The Magnetic Circuit of Dynamos."
2. "The Incandescent Electric Lamp."
3. "The Electric Meter."
4. "The Relative Advantages of Low and High Frequency in an Alternating Electric Lighting Plant."
5. "A Concise Description of a Method of Testing Transformers for Efficiency at Various Loads, both as Regards Regulation and Coal Loss."
6. "Comparison between Two and Three Phase Installations for the Long Distance Transmission of Power."

It is required that each thesis submitted in this competition shall consist of not less than 5,000 nor more than 6,000 words, and shall be written in the third person, and typewritten for publication on one side only of foolscap paper.

To admit of a fair comparison of the merits of the theses which may be submitted, keeping in view variety of subjects, a system of marks will be employed such as is generally used in college examinations, and with which the competitors in this competition are familiar. These marks will be allotted under three heads, viz.:

1. Subject Matter.
2. Arrangement.
3. English.

Taking 100 as the combined total, the maximum and minimum marks for each of the above classifications will be as follows:

Maximum.		Minimum.
50	Subject Matter	25
25	Arrangement	15
25	English	15

If any of the theses submitted should not be entitled to receive the minimum of marks as above, they will be entirely rejected.

There are three sources from which competitors must draw their subject matter, viz., books, periodicals and floating literature, personal or private channels. In judging of the subject matter, the following relative values will be attached to the above mentioned sources of information:

(a) Books	10
(b) Periodicals and floating literature	20
(c) Personal or private sources	20

50

Where extracts are used, their source and names of authors should be clearly given.

Where diagrams are required to illustrate the text, they should be drawn with pen and perfectly black ink on pure white drawing paper, bristol board or tracing linen, and in such manner as to admit of their reproduction to a small scale.

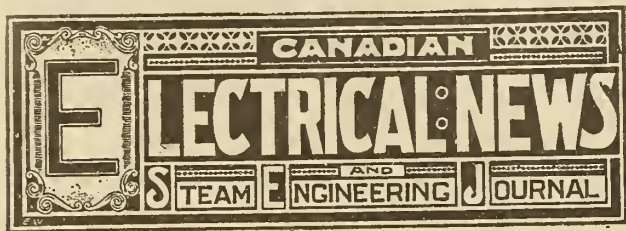
Each thesis shall be submitted by motto only, and shall be accompanied by the name of the author enclosed in a sealed envelope bearing the same motto. This envelope will remain sealed in the hands of the publishers until the competition shall have been decided.

Theses submitted in this competition must reach the C. H. Mortimer Publishing Company of Toronto, Limited, Toronto, Ont., publishers of the ELECTRICAL NEWS, before the first day of October, 1899.

A competent judge has been chosen to decide the competition in accordance with the method explained above. This gentleman, whose name will be given at a later date, will no doubt be acceptable to all concerned.

The result will be published as soon as possible after the close of the competition.

The publishers of the ELECTRICAL NEWS reserve the right to publish such of the theses submitted as in their judgment may appear to be desirable for that purpose.



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The "Canadian Electrical News" has been appointed the official paper of the Canadian Electrical Association.

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The Long Distance
Transmission Plant of a description, with numerous illustrations, of the Cataract Power Company's

plant for the transmission of electrical energy from a point near St. Catharines to the city of Hamilton, a distance of thirty-four miles. The successful completion of this undertaking marks an important point in the progress of electrical development, not only in Canada, but throughout the world, inasmuch as the generating plant is unique in many features. It is not known that turbines are operating elsewhere under so high a head, nor is it believed that current is being transmitted in daily service at so high a pressure. Again, this is presumed to be the longest distance transmission of electrical energy for power purposes in North America east of the Rocky Mountains. On the Pacific coast, where the highest price must be paid for coal, long distance transmission of power is a problem much less difficult of solution. The projectors of this enterprise had to compete with local steam plants using coal costing less than \$3 per ton. It was perhaps natural that, in connection with a problem involving so many experimental features, the original promoters should first have applied to the best known foreign engineers and manufacturers for advice as to the practicability of the scheme both from an engineering and commercial point of view. It was less natural that they should have been obliged to fall back on the resources of Canadian engineers and manufacturers. It is, however, cause for the highest gratification that these have proved themselves equal to the emergency, and that the credit of successful achievement in so important an undertaking belongs to Canada. The inference is clear that we have the men and the means to carry out the most difficult undertakings, and that until these have failed we should not go abroad for assistance. It is understood that the company's foreign advisers did not see their way clear to employ so high a voltage, owing to which fact the cost of copper was prohibitive. After careful consideration, Mr. Kammerer, the company's Canadian electrical adviser, working in conjunction with the Royal Electric Company, decided that a pressure of from 20,000 to 30,000 volts might with advantage be employed. The large saving thus effected in cost of copper went far towards insuring the commercial success of the undertaking. It is gratifying to learn that the company are not experiencing the heavy loss in their transmission lines which it was predicted would result from the use of high pressure over wires of small cross-section. Another important requisite to the commercial success of the enterprise was that the electrical machinery should be of the most efficient type. This requirement has been successfully met by the Royal Electric Company, of Montreal, with their S.K.C. system. Much credit is due

to Mr. John Patterson, in whose mind the scheme found its inception, and to the gentlemen whose portraits appear in this number as officers and directors of the company. These gentlemen pluckily stood by the enterprise through a period of much uncertainty and many discouragements. We join with all true Canadians in the wish that its future success will bring them ample reward. The fact that the Hamilton Electric Light and Power Company, and many other large users of power in Hamilton, have shut down their steam plants and contracted with the company for their power supply, seems to show that in this instance at least the steam engine has been outdone.

Central Station Management.

THE business of a lighting company is to furnish light, and not current, as appears to be the view of some. True, the bills are made out for so much current and not for so much light, but there are two parties to the bargain, and a continuance of the arrangement is dependent upon the satisfaction of both. The customer in exchange for his money, which has a pretty definite value, receives light which even in the laboratory is difficult of measurement, and he determines its value by comparison merely. If another premises is better lighted or one portion of his own lighting is better than another, or if his lamps are sometimes at normal candle power and sometimes above, he will use the better illumination as the standard, and any decrease is resented, even when it is just what he is paying for. The success of the company in the customer's eyes is measured by the brightness of the illumination given by the lamp, and this illumination is dependent not only upon the lamp itself, but upon its placing. To achieve the best results the illumination should vary as little as possible, as a continually dim light is less commented upon than if it be alternately bright and dim. This regularity is to be secured not only by a proper voltage regulation, but by choosing lamps which maintain their initial candle power as nearly as possible throughout their life. A poor lamp at start may have the same light-giving efficiency as a better one, or may even have a higher candle power for the same consumption, but its average efficiency throughout its life may be lower. Further, the lamp which gives the highest efficiency averaged throughout its life may not be as satisfactory as one of lower average, for many lamps are on the market which increase considerably in candle power during the first few hours of life and decrease thereafter rapidly, and the customer complains that the high illumination to which he has grown accustomed is not maintained. Of two lamps which commence life with an effective candle power of sixteen, one may rise to eighteen and then fall to twelve, while the other may decrease in a regular way from sixteen to twelve, and the latter will be the more satisfactory on account of its uniformity in spite of the fact that the total light given out is less during its life. Also, in replacing some of the lamps in an installation the contrast between the old and the new will be less marked in the latter case.

The rating of lamps at so many watts per candle at start is only tolerable when recognized as being not an indication of light-giving efficiency, but as a rating, for in the course of its life a lamp which begins with a consumption of 3.1 will increase to 3.5 or to 4 watts per candle—not, mark you, by the increase of current or of watts, but by the decrease of the light given out

through changes which affect the light-giving efficiency of the filament and the smutting of the globe. Again, a rating to be of use must be understood to refer to the illumination given out at a specified voltage, as the same lamp may have any consumption per candle power according to the voltage at which it operates. For instance, a 104 volt lamp which gives 16 c.p. with 4 watts per candle, if raised to 108 volts will give about 20 c.p. with 3.5 watts consumption, and if the voltage be raised still further to 112 will give about 25 c.p., or one c.p. per 3.1 watts. It is to be noted, however, that this increase in efficiency is obtained at the expense of the life of the lamp. The essential difference between a low and a high efficiency lamp is that the latter is run at a higher incandescence, and in consequence its life is shortened. It will, however, appear to be giving more light than the former at the same c.p., thus illustrating the fact that the eye is a poor photometer. In consequence of its higher incandescence, the high efficiency lamp is unable to maintain a commercially useful length of life under conditions of variation of voltage, and where they are used the regulation must be correspondingly improved. A 3.1 lamp may be satisfactory where the regulation is within 2%, while for a 4% regulation it will be necessary to use 3.5 watt lamps, and for 6% variations a 4 watt consumption or higher will be advisable. It will be seen, therefore, that without great sacrifice of life a great saving in consumption may be made by the use of higher efficiency lamps, which is made possible by better regulation. This will be to the benefit both of the customer and the station, for the former will have decreased lighting bills, while the latter will be able to increase its output without extra cost for either new plant or running charges of the present. These are benefits which will appeal to every manager, and he naturally asks what price there is to pay for the better regulation which is responsible for this increased efficiency. The price in most cases is not large; it involves apparatus for indicating in the station the state of things at the lamp and the proper lay-out of feeders and distributing mains, and close attention in the station to the regulation. Many stations have plenty of copper in place, but not in the proper place, and an intelligent study of the existing conditions will indicate where that copper should be located. Having arranged the circuits intelligently, the station attendant is kept in touch with the voltage at the lamps by means of pressure wires to the centres of distribution or by means of a compensating volt meter adjusted to the feeder drops. If in addition a recording volt meter be used at the distributing centre, the manager is in a position to check the attendant and the chain is complete.

The above remarks are of more interest to the steam station manager where running costs are higher and speed regulation better than in water power stations, but only in degree, not in kind, as he will push lamp efficiency higher than would be advisable in the latter case to save coal at the expense of the small loss due to the shorter life of the lamp. To sum up, a large saving of energy, which is costing you money, may be made by keeping your voltage as constant as possible and using lamps of an efficiency to correspond, and by a simple system of testing the lamps to ascertain that those you purchase maintain their candle power as nearly as may be possible about their initial during the period of their life.

TWELFTH ANNUAL BANQUET OF STATIONARY ENGINEERS.

THANKSGIVING Eve is awaited with some eagerness by the engineers of Toronto, as it has become synonymous with a general hand-shaking and feasting of the members of Toronto No. 1, C.A.S.E., and their friends. This year the invitations announced that the dinner would take place at the Walker House. The accommodation there provided, coupled with the unceasing effort of the dinner committee, fully maintained the reputation of Toronto No. 1 in the direction of providing social entertainment. Four tables, nicely decorated, had been provided, two extending lengthwise of the large dining hall and one across each end. These, however, were found insufficient for the large number of persons present, and a fifth table had to be arranged in the centre. The duties of chairman were performed in a most efficient manner by Mr. Charles Moseley, president of the association. Among those present, there were noticed the following :

Mayor Shaw ; Ald. S. H. Woods ; C. H. Rust, city engineer ; Prof. Galbraith, principal School of Practical Science ; A. G. Horwood, secretary Toronto Technical School ; Alex. Fraser, secretary Boiler Inspection and Insurance Co. ; A. E. Edkins, inspector Boiler Inspection and Insurance Co. ; J. S. McKay, traveller Robb Engineering Co. ; George Anderson, manager Royal Oil Co. ; James McLaughlin, traveller Queen City Oil Co. ; William Sutton, manager Wm. Sutton Compound Co. ; C. L. Weeks, General Engineering Co. ; A. M. Wickens, chief engineer parliament buildings ; James Sinclair, manager Eureka Mineral Wool Co. ; E. G. Fowler, boiler inspector ; Geo. Grant, George Grant & Co., oil merchants ; W. G. Blackgrove, inspector Boiler Inspection and Insurance Co. ; George Clapperton, Bennett & Wright Co. ; F. H. Powers, traveller Vacuum Oil Co. ; James Listner, manager Pure Gold Manufacturing Co. ; Wilson Phillips, late mechanical superintendent T. Eaton Co. ; R. C. Pettigrew, executive vice-president, Hamilton ; George Mackie, Robert Mackie and J. Ironsides, Hamilton ; John Huckley, Waterloo branch ; G. C. Mooring, chief engineer Methodist Book Room ; E. J. Philip, chief engineer T. Eaton Co. ; John Dixon, engineer new city hall ; W. J. Webb, engineer Lawlor estate building ; H. E. Terry, engineer R. G. McLean ; J. W. Marr, engineer Metropolitan Railway Company ; James Huggett, chief engineer Freehold Loan building ; John Fox, engineer O'Keffe Brewing Company ; J. G. Bain, engineer Toronto waterworks ; T. Eversfield, engineer Toronto University ; George Thompson, engineer T. Eaton Co. ; W. Bourne, Toronto Electric Light Co.

The menu was all that could be desired, and after the appetites of the guests had been appeased, some opening remarks were made by the chairman. After welcoming the guests, Mr. Moseley referred to the progress which the Stationary Engineers' Association had made. The various reports of the officers and the unanimous good feeling which prevailed among the members was, he said, a source of congratulation. The present condition of affairs demonstrated the ability of those who had preceded him in office. The opportunities afforded the members of the association of improving themselves in the various branches of engineering were each year becoming more extended, and those opportunities, united with tenacity of purpose, would no doubt result in greater advancement in the future, so that each might extend his sphere of usefulness to the betterment of the condition of his fellow-men.

After the singing of the National Anthem, the chairman proposed the toast of "Toronto, Our City," coupling therewith the names of Mayor Shaw and Ald. Woods. In replying, Mayor Shaw congratulated the association upon the large number present, which, he thought, was one of the strongest evidences of pros-

perity. He referred to the encouragement which was being given to manufacturing industries, to the deepening of the canals, and to the improvements to Toronto harbor, expressing the hope that at an early date ocean vessels would come as far as Toronto. He understood that the engineers were endeavoring to secure a license law from the Ontario government, so that no man would be allowed to take charge of an engine unless he held a certificate of competency. Incompetency, he said, not only endangered the lives of those having charge of an engine, but life in general. His remarks were greeted with applause. Ald. Woods, being called upon, expressed feelings much in sympathy with the engineers. He was in favor of organized labor, and it had been a great pleasure to him to have been of some service during the past year to one or two members of the association.

Following came the toast of "Canada, Our Home." Mr. George Anderson, manager of the Royal Oil Company, in responding, stated his belief that we had entered on an era of prosperity in Canada which would continue for many years. He hoped to see the number of chimney stacks doubled in this country, and pointed to the wonderful agricultural, industrial and mining development. He deprecated strikes, and was pleased that the Canadian Association of Stationary Engineers was an educational society, as undoubtedly there was room for mechanical improvement. Mr. Anderson concluded by telling some humorous stories, and was followed by Mr. A. M. Wickens, who referred to the question of elevators for the new city hall, stating that he was such a thorough Canadian that he would not purchase American elevators. We had a number of things in Canada to be proud of, and Canada should also be proud of the C.A.S.E., as it had established the Toronto Technical School. Engineers were getting a greater salary to-day as a result of their connection with the association. They had become more valuable to their employers.

With the toast of "The Manufacturers" were coupled the names of Mr. C. L. Weeks, of the General Engineering Company, Mr. James M. Sinclair, of the Eureka Mineral Wool Company, and Mr. James McLaughlin, of the Queen City Oil Company. Mr. Weeks said that when we left school we had only learned how to study ; then it was a question of application. He referred to the necessity of efficient employees. In their manufacturing business two forms of competition had been experienced. One of these was the cutting of prices below the point where good machinery could be produced ; the other was infringement of patent rights. In this connection the speaker incidentally referred to the suit now pending between the General Engineering Company of Canada and the American Stoker Company. The latter, he said, had infringed upon their patents in respect to mechanical stokers. Mr. Sinclair made a few pointed remarks, stating that many of the factories in Toronto were working day and night. The increase of factories would necessarily result in the employment of a larger number of engineers. Mr. McLaughlin, responding to the same toast, said that trade and commerce had lifted up the human family to its present eminence. The story of the growth of manufacturing was not alone the story of freedom, but the record of civilization, and the best evidence of freedom and well doing was the ring of the anvil and the hum of the wheels of industry. The manufacturers, by their skill,

have given cheaper and better products and added to the material welfare of the people. Canada certainly possessed advantages from her abundance of iron, copper, coal, nickel, lumber, and minerals of all kinds, but one disadvantage was the small population, scattered over such a vast country, 3,600 miles from east to west and 1,400 miles from north to south. He believed that a prosperous manufacturing industry in Canada could only be established by cultivating the markets of the world at large and by developing the agriculture of the country. Within the last few years an acceptable change had placed Canadian manufacturers on a fair footing with those of other countries. An opinion prevailed until recently that home-made goods were not equal to those imported, but to-day the products of Canadian manufactories were beginning to be appreciated, and in the markets of Europe they were taken in preference to goods of a similar kind from other countries. Touching briefly upon the oil industry, Mr. McLaughlin said that all were aware of the great difficulty there had been heretofore to obtain a good oil, either illuminating or lubricating, manufactured from Canadian crude material. To-day the oil manufactured at the Sarnia refinery defied competition either in illuminating, lubricating, or other fine products of petroleum. The Queen City Oil Company, which he represented, had recently expended a very large sum of money in the erection of a thoroughly equipped refinery at Sarnia, which he believed was one of the best on the American continent. Other Canadian manufactories had also demonstrated their capabilities. Figures were given showing our imports and exports. In 1888 we exported manufactured goods to the value of \$4,161,282; in 1897, \$9,522,014. In 1895 our total imports of all kinds were \$110,781,682, and our exports \$113,638,803. In 1896 our imports were \$118,011,508 and our exports \$121,013,852. In 1897 our imports were \$119,218,609 and our exports \$137,950,253, or \$18,741,644 more than we imported, which was \$16,000,000 in excess of the previous year and \$27,000,000 in excess of the fiscal year 94-95. Therefore, he thought we had every reason to congratulate ourselves on our prosperity, our country and our manufactories.

Prof. Galbraith, principal of the School of Practical Science, and Mr. A. G. Horwood, of the Technical School, responded to the toast of "Our Educational Interests." The former stated that this year the attendance at the School of Science and the Technical School was larger than ever before. He was fully convinced that the C.A.S.E. were following the right course in encouraging education. They were justified in using every means to improve their position. He referred to the proposal to bring Niagara power to Toronto, pointing out that it would not be in the interests of engineers, and humorously alluded to the proposal of Mr. Nicolas Tesla to transmit power without wires from Niagara Falls to New York, and even to the European continent. Mr. Horwood pointed out the relation between technical schools and the manufacturers. The British manufacturers found that Germany was capturing their trade, so the British government established technical schools after the policy of Germany, and now they were getting their trade back again.

The toast of "The Executive" was next proposed, Messrs. E. J. Phillip and A. E. Edkins, past presidents, R. C. Pettigrew, vice-president, and Geo. C. Mooring, treasurer, responding. Coupled with the toast of

"Sister Societies" were the names of Messrs. John Dixon, president Toronto No. 18, G. Mackie, vice-president of the Hamilton association, and John Huckley, of the Waterloo branch. Each of these gentlemen spoke briefly. Mr. Dixon thought that the association should take some steps to provide for aged members of the association. The toast of "The Press" was responded to by Mr. S. J. Robertson, of the Canadian Engineer, and Mr. T. S. Young, of the ELECTRICAL NEWS AND ENGINEERING JOURNAL. At this juncture Mr. Mackie proposed the toast of "Toronto, No. 1," which brought forth a reply from the president, Mr. Charles Moseley. Mr. Moseley said that the association had been of great benefit to him personally, having assisted him in an educational way. The object of the association in earlier years had been to lay a good foundation, and to-day they possessed a good library, hall, and every necessary accommodation. The toast list being concluded, the dinner was brought to a close by the singing of "Auld Lang Syne." The following gentlemen furnished the evening's musical programme: Messrs. W. G. Blackgrove, Bert Harvey, J. Litster, James Fax, Geo. W. Grant, W. H. Banfield, and E. Fisher, the latter acting as accompanist.

The dinner committee consisted of: J. Marr, chairman; George Thompson, secretary; George Mooring, treasurer; A. M. Wickens, J. Bannan, Albert Slute, W. C. Tait and J. G. Bain.

BARE WIRES AND ALTERNATING CURRENTS.

THE following letter from the city electrician of Winnipeg, Man., explains itself:

WINNIPEG, October 3, 1898.

MR. F. M. MORSE,

Secretary Winnipeg Electric Street Railway Company.

DEAR SIR,—I understand that it is the intention of the Winnipeg Electric Street Railway Company, operating the North-West Electric Company, to use the network of bare wires, forming the mains of the distributing system in connection with their proposed new system to be installed some time during the coming winter.

I further understand that it is the intention of the Winnipeg Electric Street Railway Company to employ on the aforesaid bare wires "alternating currents," using the mains as a three-wire secondary network, fed from transformers, the primaries of which, I understand, will have a difference of potential of something over 2,000 volts.

I consider that the above system, using bare overhead wires in the streets of this city, will be highly dangerous, both to life and property. It is a well-known fact that the insulation in transformers frequently breaks down, thus placing the secondaries in direct connection with the primaries; should this take place there will be a pressure of 2,000 volts between the secondary wires and the ground, forming a short circuit as soon as another ground is caused on the opposite side of the alternating circuit. Should this take place in even one transformer, the whole bare wire system, extending over miles of streets and connected to hundreds of private premises, would be thus affected.

This proposed system being thus radically different from that for which the city council authorized the use of bare wires, viz., the Edison direct current system, leads me to unhesitatingly condemn this proposed system of distribution for electric lighting in this city.

At the time of installing the North-West Electric Company's system, the representation was made as to the voltage of the direct current to be used, not to exceed 220 volts, and further that there would be a protection with guard wires on each side. This latter element of safety, I find, has not been provided.

I desire at this time to call attention to the matter so as to obviate extra expense being caused you, as I certainly would have to object to the system proposed to be used, or, to use other words, to the use which is proposed to be made of the bare wires of the North-West Electric Company's system.

Yours truly,

(Sgd.) F. A. CAMBRIDGE,
City Electrician.

MESSRS. NESS, McLAREN & BATE, MONTREAL.

It will be remembered that last spring the factory of Messrs. Ness, McLaren & Bate, at 749 Craig street, Montreal, was seriously damaged by fire, necessitating their removal to new quarters. These were found at the corner of Craig and Seigneurs street. In their new premises they put in a complete plant of special tools and machinery for the manufacture of telephones, telegraph instruments, annunciators, switchboards, fire alarm apparatus and electrical supplies of various kinds, and they now have one of the best equipped and most modern factories in Canada. A view of their premises is presented on this page, and on the following pages will be found glimpses of the interior of their factory, office and show rooms.

Messrs. Ness, McLaren & Bate advise us that at the present time they are busy in every department, and are doing almost double the volume of business which they were one year ago. Among their staff of employees there are a large number of experts, and the goods turned out are considered standard, it being the aim to make only the best quality.



STEAM BOILERS AND FROST.

AMONG the enemies which threaten the destruction of steam boilers, says the Journal of the Bavarian Society for the Inspection of Steam Boilers, frost is by no means the least formidable. The following two examples go to show that even boilers built of heavy plate and tested at high pressure cannot be exposed to the rigors of cold weather with impunity.

The boiler was, because of the scarcity of orders during the winter months, fired only two or three times per month, each time for several days, and was the rest of the time allowed to stand idle, filled with water. One fine day when the boiler, which consisted of upper and lower boiler, was being emptied and put in readiness for an inspection of the interior, it was found that the manhole cover in the rear head of the lower boiler had been forced out and the rim of the manhole badly rent and bent out of shape.

Further examination revealed a cone of ice behind the damaged boiler head. The water in the upper boiler, which was at the proper level, was covered with a crust of ice about one centimeter, 0.4 inches thick. There could be no doubt that the ice cone in question had caused the damage, the mass of ice, in freezing from the outside toward the interior, having found sufficient hold on the heads of the rivets and irregularities of the flue to cause the pressure developed by the final freezing of the core of the cone to act, instead of toward the free interior, upon the head of the boiler, until the

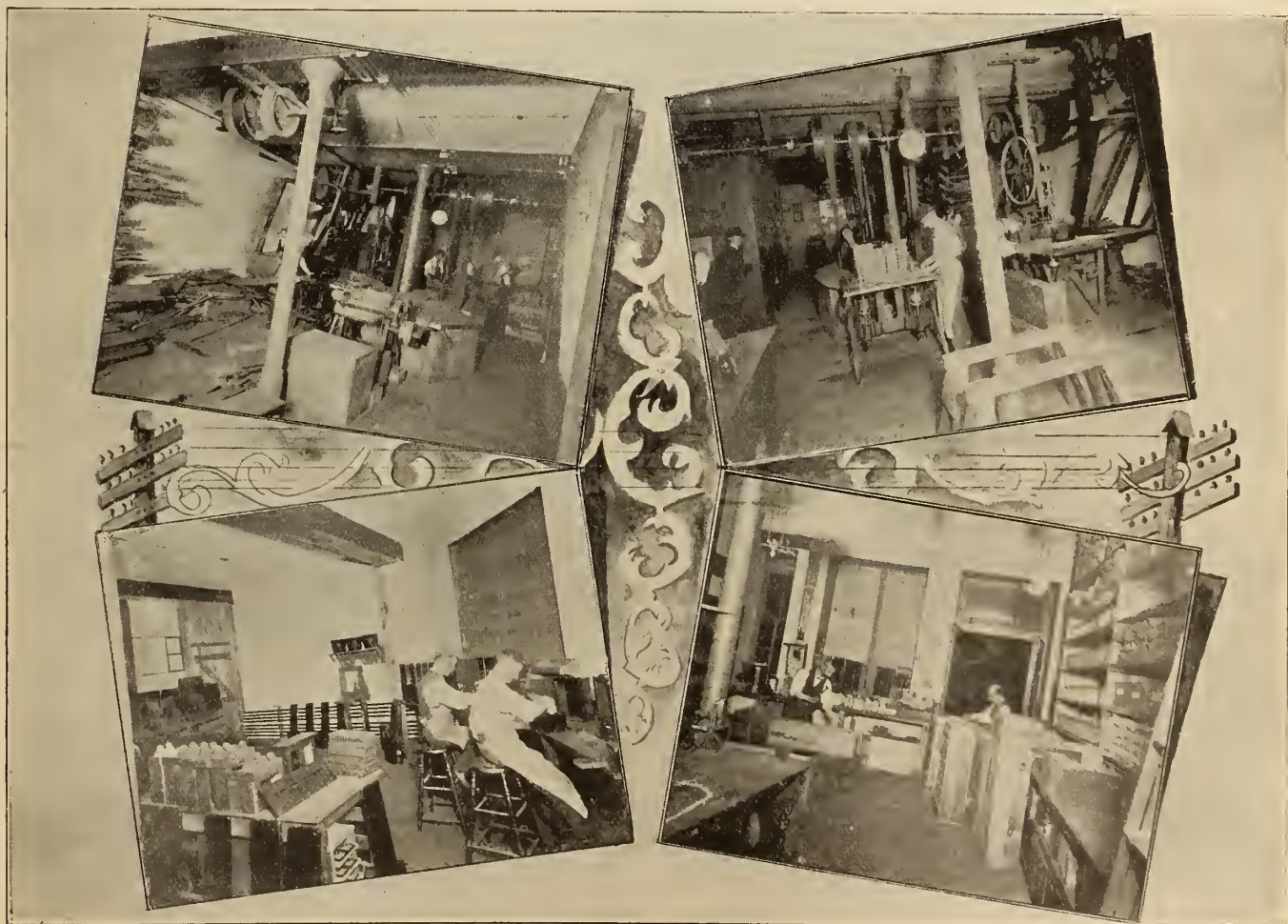
latter gave way and became rent at its weakest point—the unfortified rim of the manhole. The process of destruction was favored by the fact that the door leading from the boiler-house into the open air was only a short distance from and directly opposite the unprotected boiler head.

Another boiler, which was used only once a week, was situated in a small stone building in the middle of the farmyard.

When on a certain winter day the boiler was to be heated, it was noticed that it was rent from the mud-hole of the cross-tube along the lengthwise seam to a point beyond the fourth rivet, but that no water flowed from the rent. On opening the man-hole over the crown of the fire-box it was found that the water between the shell and fire-box, as well as in the cross-tube, had frozen, and this at once explained the cause of the damage. The cylinder of ice which had formed in the cross-tube had pressed against the shell of the boiler and had caused it to burst along the seam—its weakest spot.

These two examples demonstrate that boilers which are little used and exposed to the cold must be protected in winter against freezing, and this is effected best by discharging the water or by maintaining on cold days a light fire under the boiler or in the boiler-room.

The number of periodicals dealing exclusively or largely with electricity amounts to sixty-six. Of these eighteen are published in France, fourteen in the United States, twelve in Germany, six in England, three in Switzerland, two in Austria, Belgium, Holland, Italy and Spain, and one in Canada.



INTERIOR OF FACTORY OF MESSRS. NESS, McLAREN & BATE, MONTREAL.



OFFICE AND SHOW-ROOMS OF MESSRS. NESS, McLAREN & BATE, MONTREAL.

QUESTIONS AND ANSWERS.

"G.W.V." asks: What horse power motor would be required to run two one-inch shafts, one 82 feet and the other 48 feet in length, at a speed of 560 revolutions per minute, No. 1 shaft running 40 sewing machines and No. 2 shaft 20 sewing machines.

ANSWER.—A four horse power motor would be economical for doing the above work. A three h.p. motor might do it, if the shafts were in good shape and there was no excessive friction.

"Subscriber," Perth, Ont., writes: Kindly advise me if it is possible to change a 50 ampere 1000 volt primary Thompson-Houston alternator to run on a 2000 volt primary, without the use of step-up transformers. Can this be done by changing the connections on armature, say from multiple to series? How can I use transformers wound for 1000 volt primary, 50 volt secondary, on a 2000 volt circuit? Would it be safe to use them on a 2000 volt circuit, using 100 volt secondary, or would it be better to couple two together?

ANSWER.—If the dynamo is wound so that one-half of the coils are connected to the other half in multiple for 1000 volts, it can be easily changed to 2000 volts by connecting the two halves in series. If the coils are

already all in series, it cannot be done. You can easily see by examining the connections whether the coils are all in series or not. The transformers should run on 2000 volt primary and 100 secondary if the insulation is good enough. Modern transformers are usually wound and insulated so as to run either way. If your transformers are old and the insulation deteriorated, a doubling up of the E.M.F. may burn some of them out.

PERSONAL.

Mr. John S. Craig has been appointed electrician to the Toronto Fire Department.

Mr. John W. Keeley, the inventor of the Keeley Motor, died at his home in Philadelphia on November 18th, after a brief illness. Mr. Keeley was 61 years of age.

Mr. J. K. Ross, B.A.Sc. (McGill), who was recently appointed assistant engineer of the Birmingham Street Railway, has gone to England to enter upon his duties.

Mr. L. R. Carmichael, lecturer in mathematics and electrical engineering in Queen's University, Kingston, Ont., was recently married to Miss Jenkins, of Strang, Ont.

Mr. P. F. Hodgson, railway signal engineer for the Grand Trunk Railway, has resigned his position, to accept the management of the Saxby and Farmer Engineering Works, of London, Eng. Mr. Hodgson will assume his new duties in January.

Mr. F. A. Wunder, travelling representative for New York State and foreign countries for the Fort Wayne Electric Company, of Fort Wayne, Ind., was in Toronto last month in connection with the tendering for an electric light plant for the city.

SPARKS.

✓ The Prescott Electric Light Company, of Prescott, Ont., is announced to have assigned to W. T. Scott.

✓ The Ottawa Electric Company have completed a new flume in connection with their power house, the cost of which was \$5,000.

The Northern Electric & Manufacturing Company, of Montreal, has been authorized to increase its capital stock from \$50,000 to \$1,000,000.

A company, represented by Dennis Murphy, of Ashcroft, B.C., purposes supplying West Yale with electric power, utilizing the waters of the Thompson and Bonaparte rivers.

The cars of the Hull & Aylmer Electric Railway Company have been equipped with new head-lights. Five lamps of 16 candle power are placed together before a strong reflector.

✓ The Ottawa Electric Company has just installed what is claimed to be the largest electric light dynamo in Canada. It is of the Westinghouse type, and has a capacity of 10,000 lights.

The Bell Telephone Company is erecting a new exchange building in the city of London, Ont. It is said that this exchange will be one of the most complete in point of equipment to be found in Canada.

The council of the municipality of Rossland, B.C., have accepted the proposition of the West Kootenay Power & Light Company to furnish arc lights of 2,000 candle power, at the rate of \$96 per lamp per year.

Tenders are invited by the town of Sherbrooke, Que., for lighting the streets by arc and incandescent electric lights. The date limit is December 15th. C. W. Cate is chairman of the lighting committee.

A company of Chicago and Eastern capitalists is being formed, with a capital of \$10,000,000, for the purpose of building electric railways in Japan. The name of W. D. Eastlake has been mentioned in connection with the scheme.

"I say," said Fuddles, who sometimes thinks he is smart, "what sort of fruit can you raise on an electric plant?" But Faddles, who also thinks he is smart occasionally, promptly replied, "Currents,"—Washington Star.

It is reported that a New York company have taken an option on the plant and charter of the Canada Electric Company, of Amherst, N.S. Should the purchase be made, it is probable that the new proprietors will increase the capacity of the plant.

Mr. Hartley Gisborne, M. Can. Soc. C.E., of Winnipeg, is reported to have been appointed by the council of the Institution of Electrical Engineers, London, England, their honorary secretary and treasurer for Canada, vice Prof. Carus-Wilson, late of McGill University, resigned.

✓ The Ottawa Electric Co., Ottawa, Ont., are increasing the arc lighting capacity of their power station, and have placed an order with the Canadian General Electric Company for one of their two circuit automatic regulating "Brush" arc dynamos, having a capacity of 125 arc lamps.

The West India Electric Company, of which Mr. Henry Holgate, late of Montreal, is manager and chief engineer, expects to have 22 miles of electric railway in operation at Kingston, Jamaica, by next spring. The principal stockholder in this country is Mr. James Ross, of Montreal.

Messrs. Cornell Bros., of Stanbridge East, P.Q., are installing an electric lighting plant, and have purchased for their requirements, from the Canadian General Electric Company, a 400-light dynamo of the latest M.P. type, together with marble panel switchboard and wiring supplies.

The Montreal Belt Line Company have adopted a novel method of lighting their railway to Bout de l'Isle. An arc light reflector is located on the vestibule of the car, which does the work of a powerful search light, the smallest objects being visible to the motorman a quarter of a mile ahead.

An American inventor has submitted a scheme to the Toronto Street Railway Company to prevent overcrowding of street cars. His proposal is to fit up the cars with movable chairs, which close up automatically when not in use, and when in use increase the seating capacity by economizing space.

✓ The arbitrators in the case of the Laurentide Pulp Company and the province of Quebec, regarding water power at Shawenegan Falls, Que., have given their award. The company are to pay the sum of \$5,000 to the province, in consideration of which they will control all rights and privileges for all time to come.

Mr. A. L. Breithaupt, president of the Berlin and Waterloo Street Railway, recently made an inspection of the fender as employed on the Guelph Street Railway. He announced himself as well satisfied with its operation, and is said to have placed an order for a supply of fenders for the Berlin and Waterloo road.

On the invitation of the directors of the Canadian Electric Light Company, a number of the leading citizens of Quebec and Levis visited the company's water power at the Chaudiere Falls recently. Mr. H. M. Price, who is largely interested in the company, acted as guide, and explained to the visitors the extent of the power. The distance from the feed-head to the foot of the falls is 110 feet, while the drop is 94 feet.

The largest locomotive engine ever built in Canada has just been completed at the works of the Kingston Locomotive & Engine Company, Kingston, for the Intercolonial Railway. The driving wheels are 72 inches in diameter, the boilers designed to carry a pressure of 180 pounds to the square inch, the water tank will hold 3,000 gallons of water, and the tender nine tons of coal. The engine weighs 70 tons and the tender 44 tons, making a total weight of 144 tons.

In the Exchequer Court December 5th will be heard the argument in the suit of the General Engineering Company of Ontario vs. the American Stoker Company and the Dominion Cotton Mills Company. This is a case of an injunction granted to restrain respondents from using certain improvements in mechanical stokers, of which appellants claim the possession of the patent rights. They ask an injunction against defendants that they be prohibited from using such improvements, and be ordered to surrender them, as well as pay damages for infringement.

The Ottawa Electrical Association has taken on new life, and at a meeting held last month Mr. W. M. Wier was elected secretary, in lieu of Mr. E. Bailey, who has removed to Perth. Several members were initiated and a committee appointed to arrange for technical papers and a programme of entertainment. The association has adopted a unique and appropriate crest. The letters "O.E.A." are mounted on a horse-shoe magnet which rests upon a bank of clouds, with streaks of lightning flashing in all directions, the whole being emblematic of electricity and magnetism.

The official announcement has been made of the amalgamation of the Quebec, Montmorency & Charlevoix Railway Company, the Quebec District Railway and the Montmorency Electric Power Company. The company, which will be known as the Quebec, Montmorency & Charlevoix Railway Company, announces its intention of electrifying the road running from the city of Quebec to Cap Tourmente, a distance of about 30 miles, and to construct an independent branch to Montmorency Falls. The estimated cost of the proposed improvements is given as \$330,000, and when completed the system will comprise over 60 miles of electric railway, which will be one of the most extensive systems under one management in Canada. Mr. Edward A. Evans, C. E., is general manager and chief engineer of the consolidated system.

The Welland-Vale Mfg. Company, of St. Catharines, Ont., have increased their factory buildings and are making a change in their lighting plant. They have heretofore operated a direct current two wire system, but have decided to keep pace with the times and for this purpose are installing a 600 light alternating current two-phase S.K.C. plant, which will operate on the three-wire system, giving them a much cheaper distribution, as well as the benefit of having an inductor type dynamo, which, they believe, possesses a great many advantages over those of the old type. They are following in the lines of the Penman Mfg. Co., of Paris, and the Cockshutt Plow Co., of Brantford, who have replaced their direct current incandescent plant by inductor type machinery.

The new electric light plant at Tilbury, Ont., owned by Mr. R. H. Smith, was put in successful operation on the 14th October, and is, we learn, giving entire satisfaction. The station is a one story brick building, 36 x 26 feet, with engine room 35 x 15 feet, and boiler room 11 x 35 feet. The power equipment consists of a 60 inch by 12 feet tubular boiler, Northey steam duplex feed pump and heater, and Leonard-Ball automatic high speed engine. The electrical apparatus comprises two 15 k.w. Edison bi-polar 125 volt dynamos, operating on the three-wire system, with white marble switchboard and full complement of instruments, and one 35 light Reliance dynamo and polished skeleton switchboard and necessary instruments. There are in use 13 arc lights for street purposes and over 300 incandescent lights. The plant, which was installed by the Canadian General Electric Company, is in charge of Mr. Joseph H. Ward, who for some time was superintendent of the St. Mary's electric light plant.

The Edison Electric Company, in New York, has just decided to make an experiment which may result in a wonderful increase in its business, as well as in revolutionizing the domestic economy of many homes. The company has reduced the price for domestic lighting to three-fourths of a cent an hour for each incandescent lamp of 16 candle power, the offer to be good for three months, with a promise to make yearly contracts at that rate. If the people show a disposition to adopt electricity in place of gas which will warrant it, the low rate will be made permanent. Not only does the company purpose invading the field of domestic lighting, but it will offer special inducements to those who desire to use electricity for cooking purposes, even though such use at the best price which can be made would be a luxury at present. Nevertheless, the company displays a complete electric kitchen in its office, where practical demonstrations are made of the various appliances for cooking and heating.

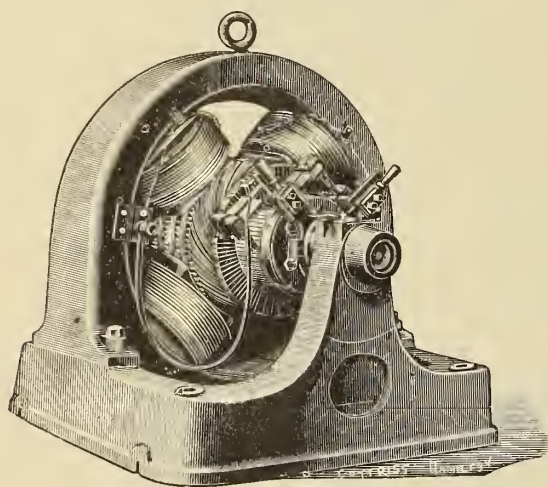
The Parry Sound Electric Light Company, of Parry Sound, Ont., has just completed the installation of new water wheels, purchased from Charles Barber, of Meaford, Ont. They comprise two 42-inch improved Canadian turbines, horizontally set. Work was commenced in September, a pit being blasted out of the solid rock some ten feet to the south of the old mill building; a stone foundation was built around the wheel pit to support the bulkhead, and rock bolts were carried up through this foundation to secure the floor of the bulkhead from any possibility of shifting its position. A floor of 12-inch timber was placed across the foundation, and on this the bulkhead, 8 x 16 feet and 18 feet high, was erected. A draft tube, 5 feet 6 inches long, extends from the floor of the bulkhead down into the wheel pit, and, being air tight, the water, in falling through it after leaving the wheels, exerts as much force as the same amount of water would if above the wheel. The speed of the wheel shaft being 128 revolutions per minute, and the proper speed of the line shaft 15 revolutions per minute, it was necessary to belt from a 72-inch pulley on the wheel shaft to a 28-inch pulley on the line shaft. The connection is made by a double leather endless belt 20 inches wide and 64 feet in length, supplied by the J. C. McLaren Belting Company, of Montreal. At present the head of water is 21 feet, and the wheels are developing about 200 horse power. The work was carried out under the superintendence of Mr. W. H. Train, of Burk's Falls.

HIGH CLASS GENERATORS AND MOTORS.

IN order to meet the growing demand for direct current electrical machinery of a higher order of excellence than that heretofore usually offered, the Toronto and Hamilton Electric Company, of Hamilton, have prepared designs for a line of machinery which is claimed to embody the most modern features of correct electrical and mechanical construction. Regarding these machines the manufacturers say: In these the highest possible efficiency is obtained compatible with moderate speeds, and their output is based on a low temperature rise. Careful attention has been given in the matter of correct saturation of the armature teeth, while the density of the remainder of the magnetic circuit is such as to require a minimum current for excitation and least loss, in compounding against armature drop and reaction.

The reluctance of the air gap is reduced and a proper distribution of the flux is obtained by the use of a correctly shaped pole shoe, and as a result the brushes do not spark under different loads.

The energizing coils are circular in form, and their careful and even winding results in a high insulation resistance and affords the most economical ratio of turns to weight and length. The armature coils are form wound and thoroughly insulated, and the winding



is perfectly symmetrical and balanced. The commutator is massive, made from the best copper, and wholly insulated with mica. Mechanically, the machine is unsurpassed. The armature is built on an open-work hub, which allows of thorough ventilation, and the commutator is directly keyed to same hub, the two forming a unit independent of the shaft, thus eliminating all strain at the armature leads, which often obtains in some types of machine by commutator working loose on the shaft.

The shaft is of the best machinery steel, generously proportioned and carefully finished, and runs in gun metal bearings of the self-oiling and self-aligning variety. The pedestal seats are bored at the same operation with the poles, the pedestals being carefully turned to suit, and this construction insures perfect concentricity of the armature and field magnet, and a regular air gap, important matters in a multipolar machine. The yoke crown is of soft cast iron, the magnet limbs of round wrought iron, and the pole shoes of cast steel, a combination which practice has shown to give the best results for either generators or motors, and to possess the finest regulating qualities.

The excellent balance, generous weight of metal and low centre of gravity insures the smoothest attainable running qualities.

The accompanying cut clearly illustrates the general outline of the belted machine as made in sizes ranging from $7\frac{1}{2}$ to 30 kilowatts, the same being of course suitable to direct connection, their capacities being based on a speed consideration.

The Richelieu and Ontario Navigation Company purpose installing a new electric light plant in the steamer Richelieu. Her boilers and engines will also be overhauled.

SPARKS.

The ratepayers of the town of Liverpool, N.S., has voted in favor of expending the sum of \$31,000 for installing an electric light plant and waterworks system.

The city council of Toronto, Ont., has requested the street railway company to make a trial of various fenders, with a view to the adoption of the one found most efficient.

The town of Neepawa, Man., has deferred the installation of its electric light and telephone plant until next spring. An electrician for same has not yet been appointed.

Sir Charles Ross, president of the West Kootenay Light and Power Company, states that it is the intention to make further improvements and additions to the plant next year.

The town council of Cornwall, Ont., is considering the question of putting in apparatus for operating the waterworks by water power. Mr. Weller, C.E., is acting as consulting engineer.

Mr. James Johnston, electrician of the Department of Public Works, Ottawa, is preparing plans for an electric light plant to be installed at Kingston, Ont., for lighting the graving dock.

The time for receiving tenders for an electrical power transmission plant for the town of Orillia, Ont., has been extended to December 10th. Mr. Roderick J. Parke is consulting engineer.

Tenders for the installation of electrical power for operating the locks, bridges, etc., and lighting the Soulages canal, closed at the Department of Public Works, Ottawa, on December 1st. The result has not yet been learned.

Directors of the Lake Megantic Electric Light Company, Lake Megantic, Que., have been elected as follows: Rev. Father Choquet, president; Dr. Codiere, secretary; L. Becigneul, treasurer; C. A. Leger, managing director.

The ELECTRICAL NEWS was last week favored by a visit from Mr. T. C. Frenyear, manager of the Buffalo office of the Westinghouse Electric and Manufacturing Company, of Pittsburg, Pa. The Buffalo office of this company is now located at 782 Ellicott Square.

The lectures on "Steam and the Steam Engine" at the Toronto Technical School are now given on Thursday instead of Friday evening. This change has been made in order that the large lecture room on the first floor may be used, as well as the electrical apparatus for illustrating.

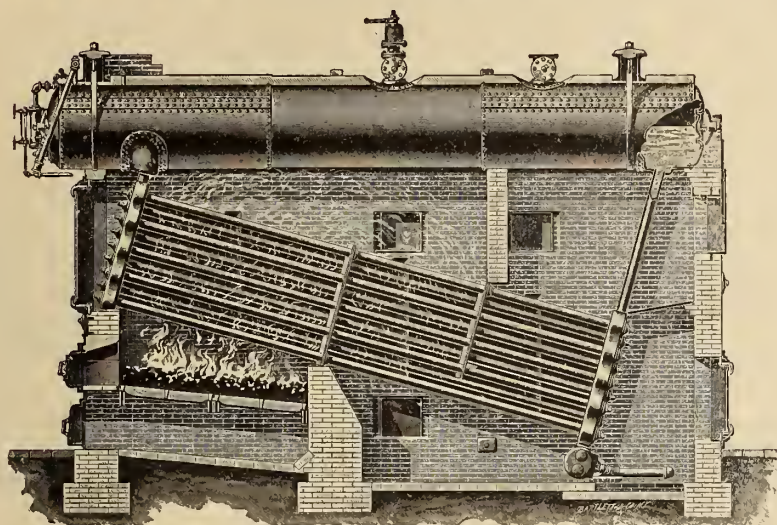
Judge Davidson has dismissed the case of Albert Besner vs. Montreal Street Railway Company. The plaintiff claimed \$280 damages on account of the killing of his horse and injuries to himself. The court held that the company was not to blame, as the car was slowing up when it neared Gabriel street, and stopped within sixty feet. It was shown that the plaintiff was driving rapidly and tried to cross the track, instead of remaining on the south side of the street, where there was a vacant space of over 19 feet.

Mr. James Ross, vice-president of the Montreal Street Railway Company, returned from England recently. Speaking of electric transportation, he stated that the overhead system has become to be generally accepted in Great Britain, the cities of Glasgow and Liverpool each having several miles in operation. Dublin and Bristol are also to have trolley lines. As to the Birmingham system, in which Mr. Ross is financially interested, little progress has been made. The people have not yet decided what course to pursue.

The city of Hull, Que., received the following tenders for lighting the streets by sixty arc lamps: Ottawa Electric Company, 1,600 c.p. lamps, \$49.50 each per year, or 2,000 c.p. lamps at \$65 each; Hull Electric Company, 2,000 c.p. lamps, \$62.50 each per year. The council decided not to accept either of these tenders, but to obtain estimates of the cost of installing a municipal plant. Mr. Farley has submitted to the council the desired estimates, which show that a complete plant of sixty arc lamps, with poles, wires, etc., would cost \$4,938. The improvements of water power on Bowery Creek, including water wheels, flume and building, is placed at a cost of \$4,060, and the running expenses of the plant at \$2,075. It is probable that tenders for a plant will be invited, although the Hull Electric Company claim that in the year 1894 they were given the exclusive right to furnish electricity in Hull for a period of 35 years.

Owing to the small number of tenders received by the city council of Toronto for the installation of a municipal electric light plant, it has been decided to accept none of the tenders. From the tenders submitted it was found impossible to arrive at even an approximate cost of an electric plant. No tenders were received from Canadian manufacturers. It will be remembered that in the year 1894 similar tenders were asked for by the city, and bids were submitted by fourteen firms. The Bertram Engine Works Company were the lowest tenderers for engines and the Brush Electric Company for dynamos and lamps. In this case, as in the present instance, no further steps towards the establishment of a plant were taken. In this connection we observe that the Anglo-American Electric and Supply Company, represented by Messrs. H. M. East, G. P. Magann, Dr. R. A. Pyne, M.P.P., and G. S. Ransom, have made a proposition to supply electric energy to the city. The company ask similar privileges to those enjoyed by other companies, the right to use the street for carrying wires, and generally the powers necessary and incidental to the carrying out of an electric lighting power and supply business. Power is offered at cost after paying a dividend of 10 per cent. to the shareholders upon a capital stock of \$5,000,000. It is guaranteed that the cost to the public will not exceed one cent per horse power per hour.

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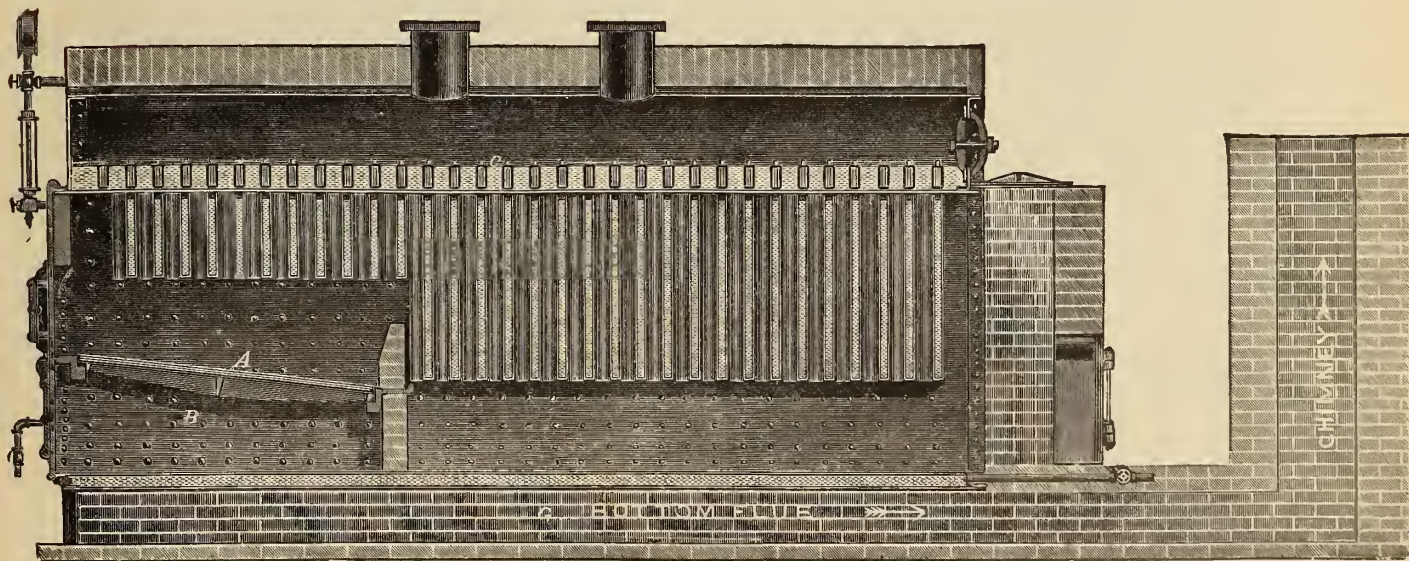
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SPARKS.

There is some talk of the electric railway at Peterboro', Ont., being extended to neighboring villages.

The town of Windsor, N.S., is considering the advisability of installing an electric plant for street lighting.

The Little Salmon River Telephone Company has been granted the privilege of carrying its line into St. John, N.B.

The Canadian General Electric Company are installing a 100-light electric plant for the Guelph Carpet Company, of Guelph, Ont.

The electric light plant at Cookshire, Que., is nearing completion, and it is expected that the light will be available early this month.

The Stromberg-Carison Telephone Manufacturing Company, of Chicago, are said to be considering the establishment of a factory in Canada.

The Montreal Street Railway Company are said to be experimenting with some of the latest inventions for the purpose of consuming smoke.

It is understood that the Mimico Electric Railway Company have decided to extend their railway to the Long Branch ranges, work to be commenced after the new year.

John Kerr, who was injured by a collision on the street railway at Sherbrooke, Que., while employed as a motorman, has instituted a claim for \$7,500 against the company.

The Board of Trade of Parry Sound has appointed a committee to obtain information as to the cost of constructing an electric railway to connect Parry Sound and Depot Harbor.

J. E. Valois has been appointed a commissioner to inquire into the management of the electric light system in Lachute, Que., at present under the control of Mr. J. M. Fulton, liquidator.

On December 17th the ratepayers of Galt, Ont., will vote on a by-law to raise \$67,750 to purchase the gas and electric light plants. The company owning these plants has offered to sell at that figure.

The British Columbia Telephone Company, Limited, are seeking enlarged powers, to enable them to absorb the business of the New Westminster and Burrard Inlet and Vernon and Nelson telephone companies.

A report is current that an English syndicate is preparing to build a pulp mill in the Saguenay district, province of Quebec, and that the construction of an electric railway from Alma Island to Tadousac is part of the scheme.

The Toronto Electric Light Company have placed an order with the Canadian General Electric Company for a large power generator of the latest multipolar type. This machine is to be wound to deliver current at 250 volts pressure, and has a capacity of 600 h.p.

The tender of Alex. Anderson, Toronto, for installing an electric fire alarm system for Owen Sound, Ont., has been recommended for acceptance, the price being \$1,225. The other tenderers were: Parker & Co., Owen Sound; Rodgers Electric Company, Toronto; Geo. Scott, Oshawa; Bell Telephone Company.

The Canadian Peat Fuel Company recently conducted some experiments at Trenton on a locomotive of the Central Ontario Railway Company, using peat as fuel. A train of 22 freight cars was drawn over a distance of 30 miles, a considerable portion of which was heavily graded. The master mechanic of the railway company is said to have pronounced the results as extremely satisfactory.

The Railway Committee of the Privy Council has refused the application of the Ottawa Electric Street Railway for permission to cross the Canada Atlantic Railway tracks at Elgin street, Ottawa, so as to continue their line to the exhibition grounds. This case is interesting, inasmuch as the city issued an injunction against the street railway company to compel them to continue this line.

The lighting plant of the Stouffville Electric Light Company, of Stouffville, Ont., which was installed about 5 years ago, suffered damage a short time ago by the armature bands breaking and wrecking the machine. In replacing this dynamo, they installed an S.K.C. inductor type machine, which will, at least, do away with the possibility of having another wrecked armature, or a burn-out, or troubles from brushes and commutators. The plant, as remodelled, is strictly up-to-date.

TRADE NOTES.

The Davidson Manufacturing Company, of Montreal, Que., have purchased a 30 h.p. induction motor from the Canadian General Electric Company.

The Canadian General Electric Company are installing an electric plant of 100 lights capacity for the Williams Shoe Company, of Brampton, Ont.

C. O. Beauchemin, Montreal, P. Q., has purchased from the Canadian General Electric Company a 30 kilowatt generator of the latter company's latest multipolar type.

The Mispic Pulp Mills, of St. John, N. B., are installing an electric lighting plant, and have purchased a 400-light dynamo from the Canadian General Electric Company.

O. & W. McVean, of Dresden, are installing an electric lighting plant for use throughout their various mills. The Canadian General Electric Company are furnishing all the apparatus and wiring supplies.

The Canadian General Electric Company have recently closed a contract with Messrs. Geo. Matthews Company, of Peterboro', for the installation of electric lighting plant, the dynamo to have a capacity for 150 lights.

The Penberthy Injector Company, of Detroit, Mich., is announced to have won its suit against the Lee-Penberthy Mfg. Company, restraining the latter company from using the name Penberthy on its goods.

Mr. A. E. Payne, E.E., who has been associated with the Royal Electric Company for the past four years, will in the future represent the Packard Electric Co., of St. Catharines, and Mr. R. E. T. Pringle, Montreal. His friends throughout the country will be pleased to learn that Mr. Payne will be able to offer them the standard apparatus and lamps of the Packard Company, as well as the very large line of supplies handled and kept in stock by Mr. Pringle.

PUBLICATIONS.

The Robb Engineering Company, Limited, of Amherst, N. S., have issued a condensed catalogue of their engines and boilers. The booklet contains views of their Robb-Armstrong simple, tandem and cross compound centre crank and side crank engines, the Mumford improved boiler, with sectional views thereof, portable boiler and engine, and return tubular boiler, together with some selected testimonials from customers.

The Executive Committee of the Canadian Association of Stationary Engineers have favored us with a copy of a handbook of engineering information compiled in accordance with a resolution passed at the annual convention of the society held in Brockville on August 16th, 1897. The book contains nearly 300 pages, nicely printed, bound in leather, and is replete with valuable tables and data of every-day use to engineers. Copies may be obtained from Mr. J. G. Robertson, executive secretary, Montreal.

The first number of the American Street Railway Directory and Buyers' Guide has been issued by Mr. E. L. Powers, of New York and Chicago, and contains a complete list, with general statistics, of the electric, cable, horse and elevated railways in the United States and Canada. This directory was formerly published as a feature of the magazine "Electrical Industries." Later, when this publication became merged into the "American Electrician," the railway and lighting directories were both incorporated into the "Standard Electrical Directory." Owing to the pressing demand, however, for a purely class publication, it was decided to issue the Street Railway Directory separately.

We have received from Mr. W. T. Bonner, of Montreal, manager of the Canadian branch of Messrs. Babcock and Wilcox, Ltd., a copy of the 30th edition of their book entitled "Steam." This book contains much valuable information regarding the subject of steam generation and the economy of steam plants generally. The articles bearing on the construction, erection and operation of the Babcock and Wilcox water tube boilers are especially interesting, while the rules and practical data make it valuable to engineers and steam users in general. It is also profusely illustrated. We learn that each edition of this book includes two or more issues of from 1,000 to 5,000 copies, and that it is sent free to all applicants. The Babcock and Wilcox Company are therefore entitled to considerable credit for their efforts in an educational way.

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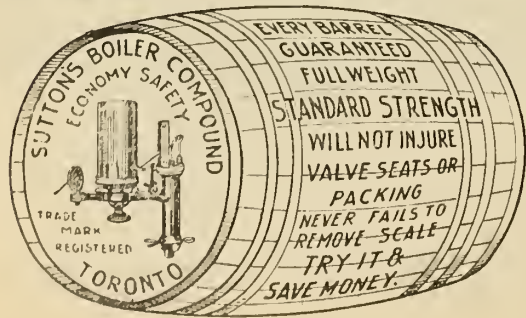
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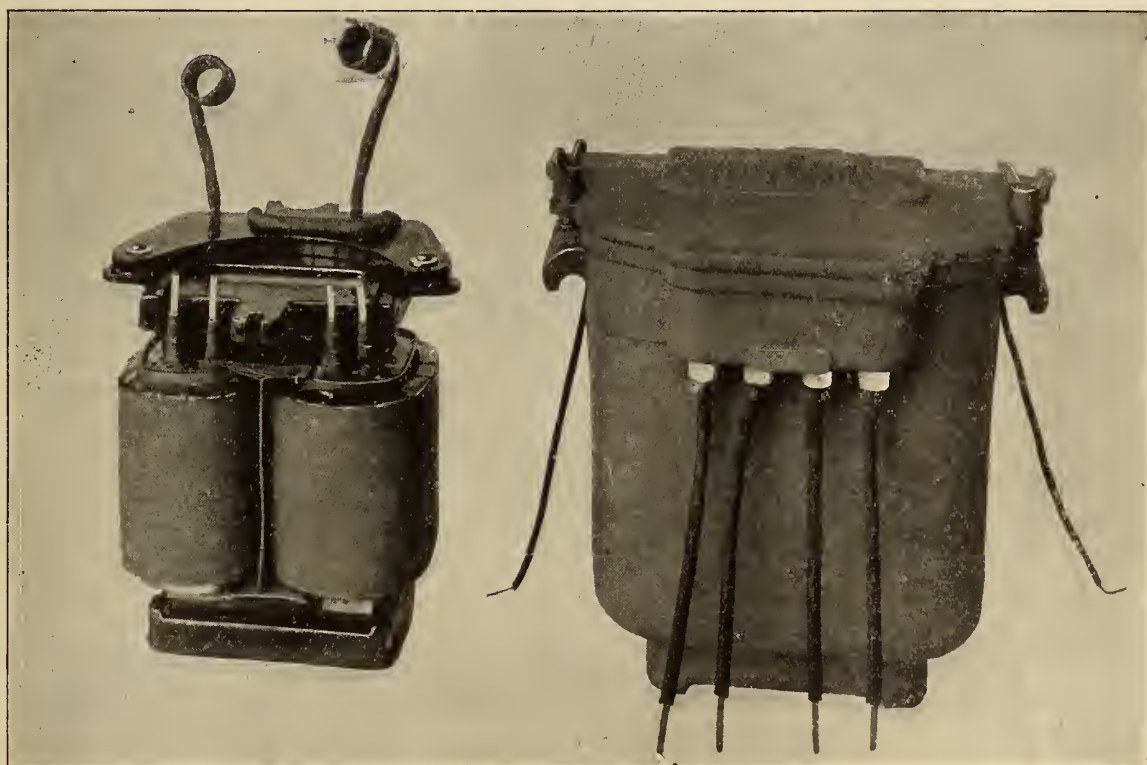
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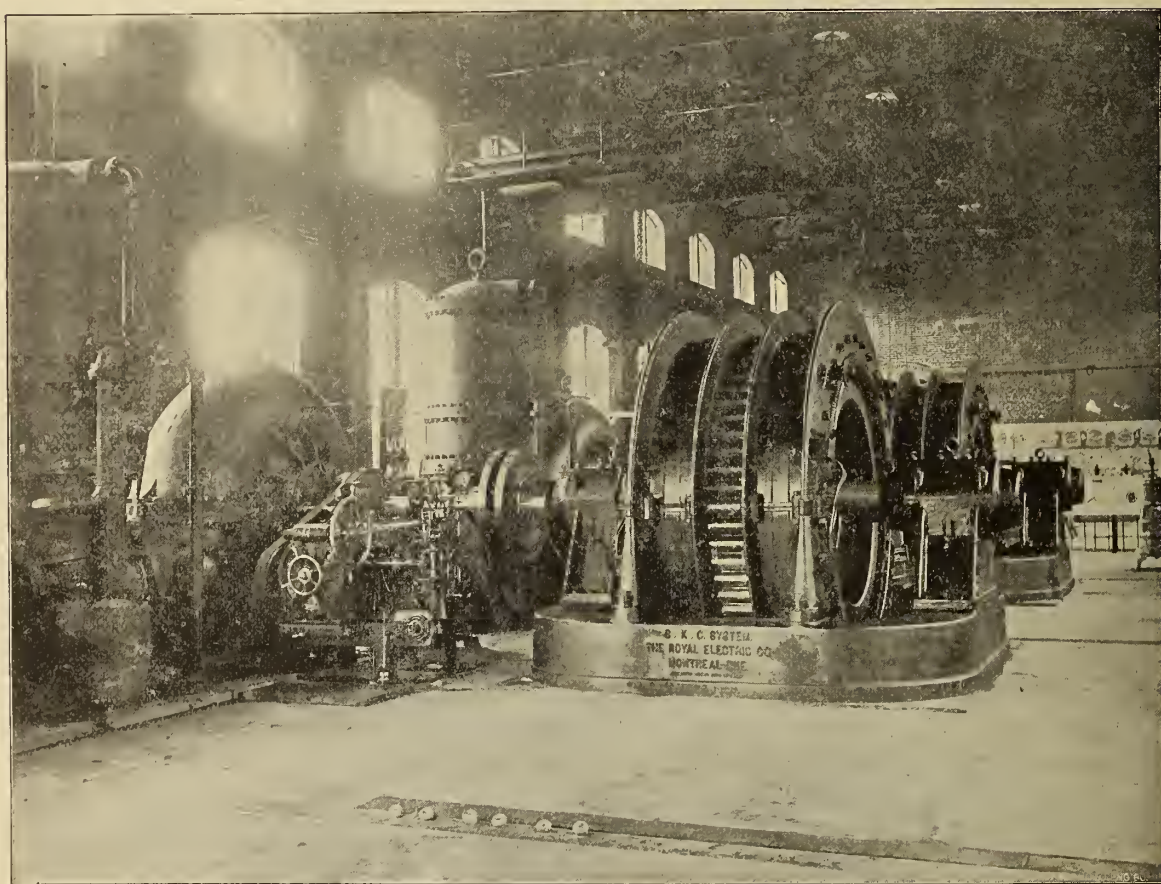
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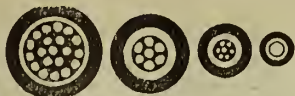
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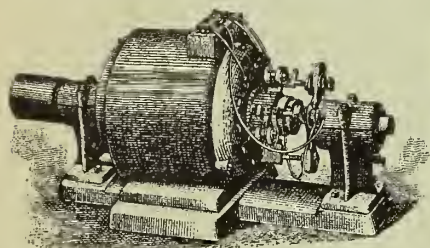
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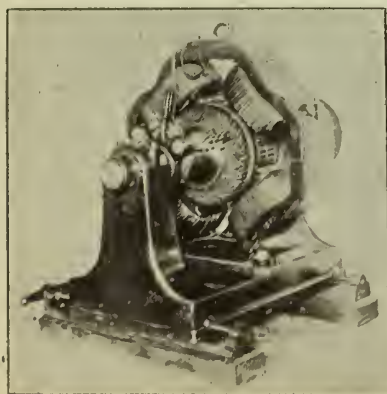
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